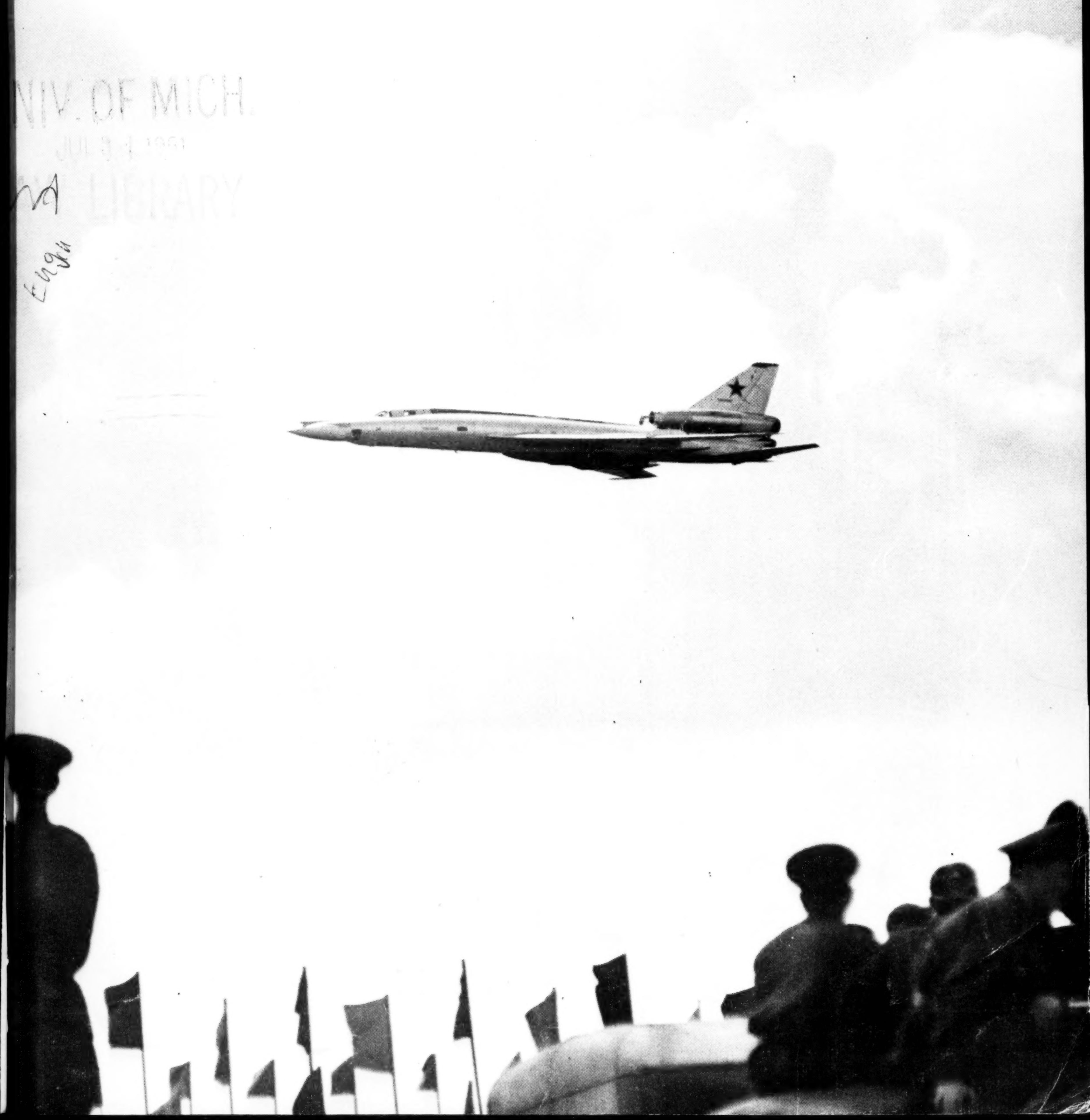
# Aviation Week
# and Space Technology

July 31, 1961

## First Pictures Of Lockheed's Light Helicopter

Soviet Beauty Mach 2 Bomber



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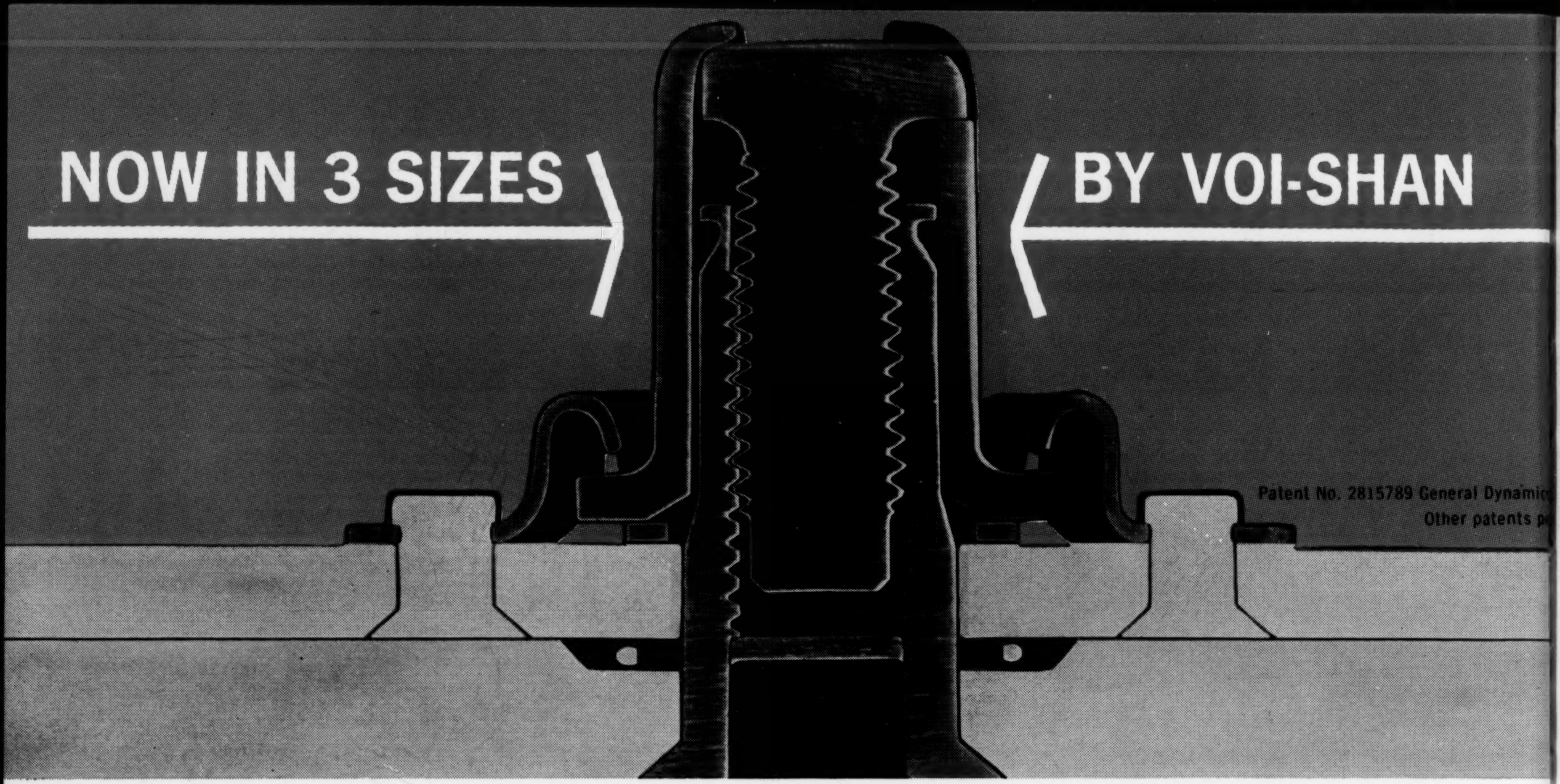

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| Milson 1900-5 | .312 | 4,750 | 3,500 | .875 |
| NAS 547 #1 | .375 | 4,650 | 2,210 | .875 |
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## AVIATION CALENDAR

**Aug. 7-9**—Guidance and Navigation Conference, American Rocket Society, Stanford University, Palo Alto, Calif.

**Aug. 15-17**—Cryogenic Engineering Conference, University of Michigan, Ann Arbor.

**Aug. 16-18**—International Hypersonics Conference, American Rocket Society, MIT, Cambridge, Mass.

**Aug. 19-24**—Institute of the Aerospace Sciences/Naval Aviation Meeting, San Diego, Calif. (classified).

**Aug. 22-25**—Western Electronic Show and Convention, Cow Palace, San Francisco.

**Aug. 23-25**—Fourth Biennial Gas Dynamics Symposium, American Rocket Society, Northwestern Technological Institute, Evanston, Ill.

**Aug. 24-26**—Sixth Annual National Reunion, OX5 Club of America, Allis Hotel, Wichita, Kan.

**Aug. 28-30**—West Coast Conference of Applied Mechanics, University of Washington, Seattle, Wash.

**Aug. 28-Sept. 1**—International Heat Transfer Conference, University of Colorado, Boulder, Colo.

**Aug. 28-Sept. 1**—Third International Symposium on Rockets and Astronautics, Japanese Rocket Society, Tokyo, Japan.

**Aug. 30-Sept. 1**—Second Annual Bionics Symposium, General Electric Advanced Electronics Center, Cornell University, Ithaca, N. Y.

**Aug. 30-Sept. 1**—Third Annual Semiconductor Conference, American Institute of Mining, Metallurgical and Petroleum En-

(*Continued on page 6*)

**AVIATION WEEK and Space Technology**

July 31, 1961
Vol. 75, No. 5

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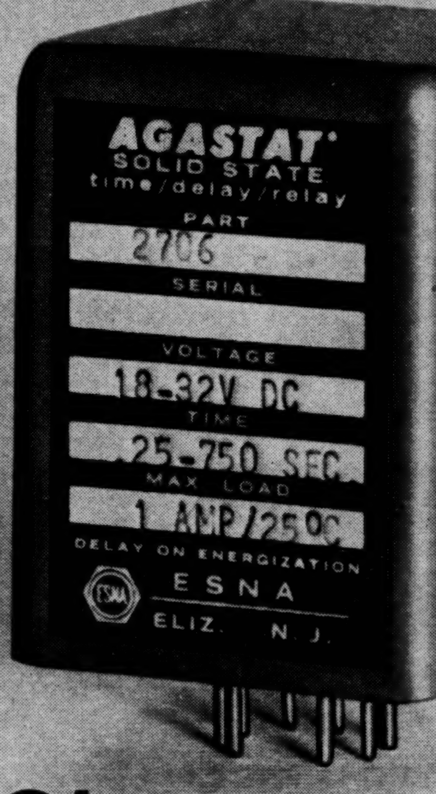

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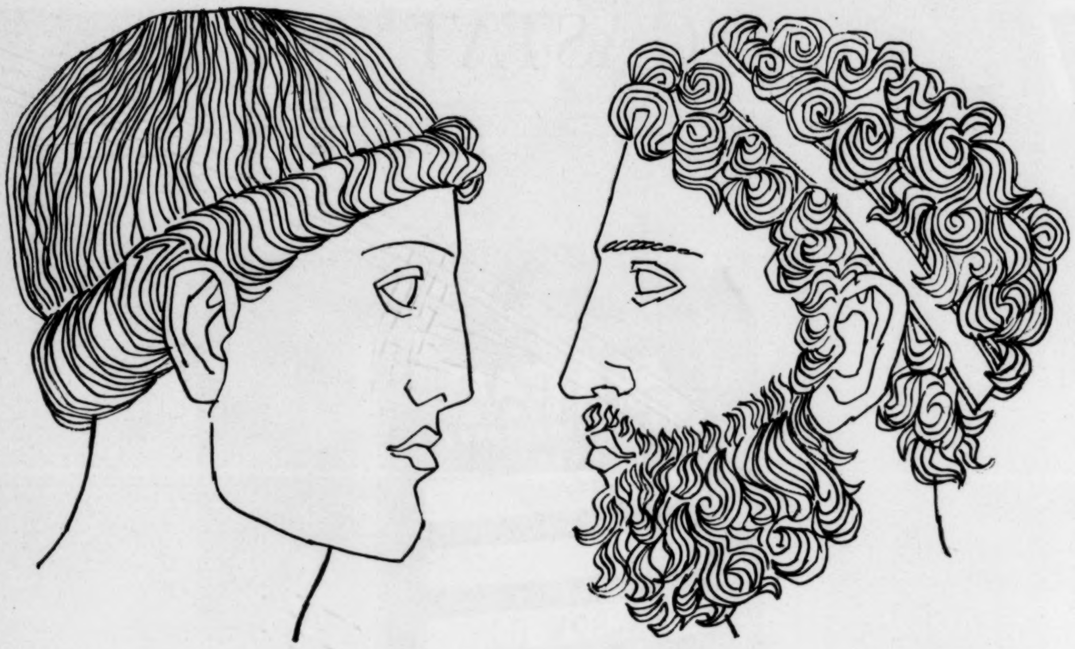
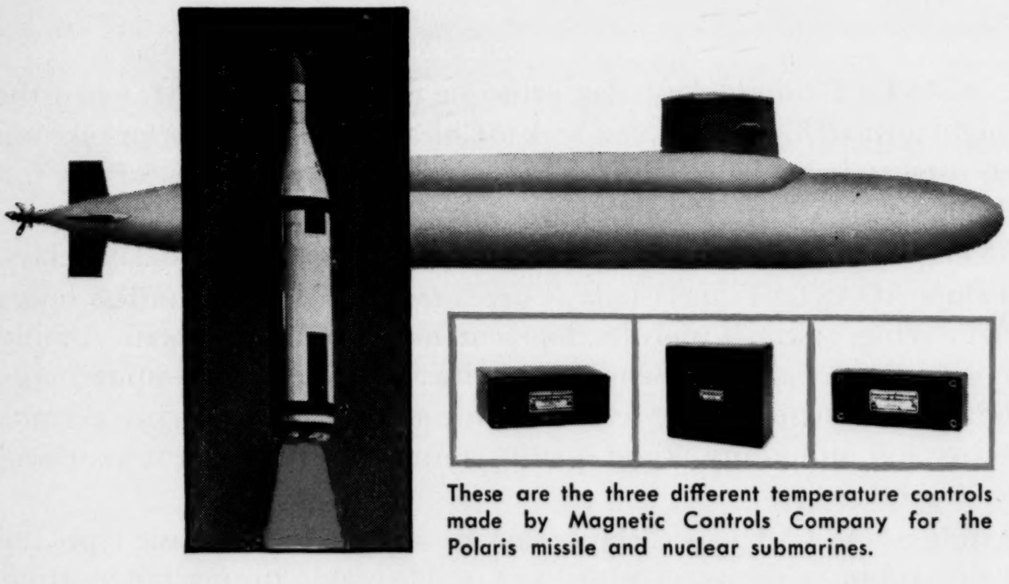


In Julius Caesar's time the "buyword" was "*caveat emptor* – let the buyer beware". Today, however, "the burden of proof – *onus probandi*" is on the seller. In the field of electronics Magnetic Controls Company has the proof. EXAMPLE: The Polaris carrying nuclear submarine *George Washington* is equipped with 34 precision temperature control systems designed and manufactured by Magnetic Controls Company for M.I.T., General Electric and Autonetics Division of North American Aviation. All 34 of these systems have functioned perfectly, with no failure of any kind, during their first full year of service aboard the *George Washington.*



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## AVIATION CALENDAR

(*Continued from page 5*)

gineers, Ambassador Hotel, Los Angeles.

**Sept. 4-10**—1961 Flying Display and Exhibition, Society of British Aircraft Constructors. Farnborough, England.

**Sept. 4-14**—Eighth Anglo-American Aeronautical Conference, Royal Aeronautical Society and Institute of the Aerospace Sciences, London, England. Wilbur Wright Memorial Lecture, Sept. 12.

**Sept. 6-8**—National Symposium on Space Electronics and Telemetry, Institute of Radio Engineers, University of New Mexico, Albuquerque, N. M.

**Sept. 6-8**—Joint Nuclear Instrumentation Symposium, North Carolina State College, Raleigh, N. C. Sponsors: American Institute of Electrical Engineers; Instrument Society of America; Institute of Radio Engineers.

**Sept. 7-8**—Fall Meeting, Western States Section/The Combustion Institute. University of California, Berkeley, Calif.

**Sept. 10-12**—National Convention, National Aeronautic Assn., Westbury, N. Y.

**Sept. 13-14**—International Operations and Maintenance Symposium, Airwork Corp., Millville, N. J.

**Sept. 13-15**—16th Annual Meeting, Armed Forces Chemical Assn., Statler-Hilton Hotel, Washington, D. C.

**Sept. 14-15**—Ninth Annual Joint Societies Engineering-Management Conference, IRE, Hotel Roosevelt, New York, N. Y.

**Sept. 15-17**—Annual Convention, National Assn. of State Aviation Officials, Miami Beach, Fla.

**Sept. 20-21**—Industrial Electronics Symposium, Institute of Radio Engineers, Bradford Hotel, Boston, Mass.

**Sept. 20-24**—National Convention and Aerospace Panorama, Air Force Assn., Philadelphia, Pa.

**Sept. 26-28**—Annual Convention, National Business Aircraft Assn., Mayo Hotel, Tulsa, Okla.

**Sept. 29-30**—Society of Experimental Test Pilots' Fifth Annual Symposium and Awards Banquet, Beverly-Hilton Hotel, Beverly Hills, Calif.

**Oct. 2-4**—Seventh National Communications Symposium, Institute of Radio Engineers, Hotel Utica, Utica, N. Y.

**Oct. 2-7**—12th International Astronautical Congress, Washington, D. C.

**Oct. 3-5**—National Airports Conference, University of Oklahoma, Norman, Okla.

**Oct. 9-13**—National Aerospace Engineering & Manufacturing Meeting, Society of Automotive Engineers, Ambassador Hotel, Los Angeles, Calif.

**Oct. 9-15**—American Rocket Society's 16th Annual Meeting & Space Flight Report to the Nation, Coliseum, New York, N. Y.

**Oct. 14-22**—Federation Aeronautique Internationale 1961 General Conference, Hotel Quintandinha, Rio de Janeiro, Brazil.

**Oct. 23-24**—Joint Meeting, Canadian Aeronautical Institute/Institute of the Aerospace Sciences, Ottawa, Canada.

**Oct. 23-27**—17th Annual General Meeting, International Air Transport Assn., Sydney, Australia.

**Oct. 24-26**—International Symposium on Aero-Space Nuclear Propulsion, Institute of Radio Engineers, Riviera Hotel, Las Vegas, Nev.

July 31, 1961

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**COVER:** Soviet Beauty Mach 2 heavy bomber carrying a ballistic type air-to-air missile makes a low pass at the Tushino air show as Red soldiers look on. Twin-turbojet-powered Beauty has nose probe for aerial refueling (AW July 24, p. 26; July 17, p. 26, 31).

**PICTURE CREDITS**

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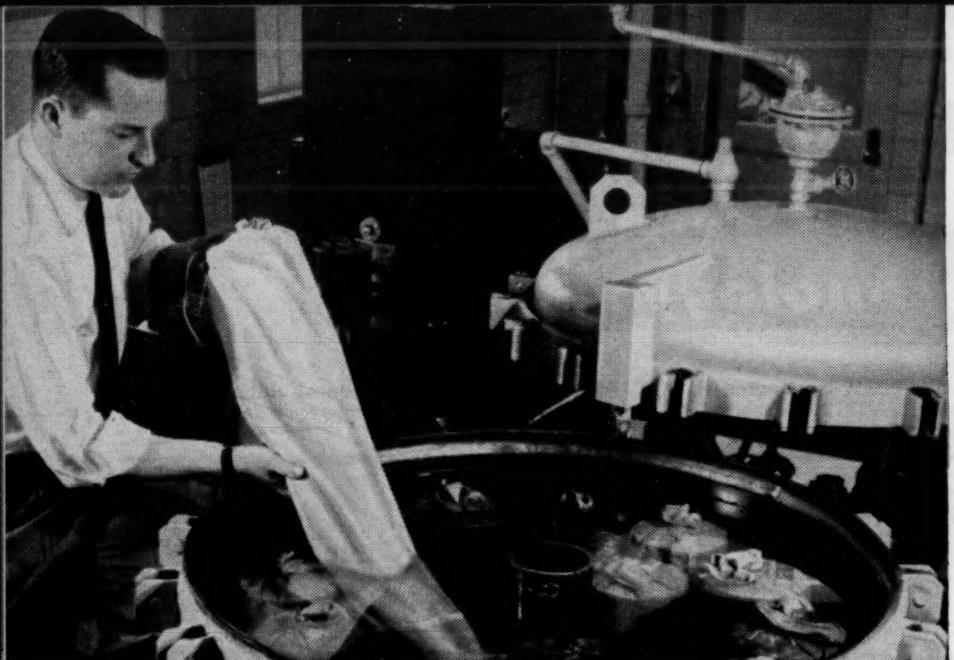

LOCKHEED JETSTAR—FIRST U. S. CORPORATE TURBOJET

**Left:** Shell engineer tests filter-separator at the AeroShell Turbine Fuel Equipment Laboratory—first in the U. S. **Right:** New Lockheed JetStar refuels. Shell sold over one billion gallons of aviation fuel last year.

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# EDITORIAL

## Laying It on the Line

President Kennedy's speech to the nation last week was an address that just had to be made at this particular time. It was directed to Nikita Khrushchev as much as to the American people, and it told him loudly and clearly that there must be an end to his policy of gobbling up new communist conquests or he must face the fact of war.

Three times in modern history major wars have begun because the great powers of Europe were certain that the United States would not go to war, and three times they have been wrong—in World War I and II and in Korea. Each time, a firm declaration of United States policy before the war began, with a clear definition of the line beyond which this nation would not be pushed, might have discouraged the aggression that ensued.

President Kennedy apparently is trying to avoid this possibility of miscalculation of our intentions by communist leaders. In this task, he faces formidable problems because so many of our actions during the past few years have indicated to the Communists that we had become completely self-centered in our prosperous environment and couldn't care less about the troubles of people being crushed under the communist juggernaut in places where the geography was even more confusing to Americans than the politics. We think this has been a dangerous illusion for any aggressor during the 20th century.

It is too bad that Mr. Khrushchev cannot consult Kaiser Wilhelm and the German field marshals of 1918 vintage, Mussolini, Hitler, the Japanese admirals of 1941 vintage and his own predecessor and political tutor, Stalin, on how the American people surprised them by failing to retain their remote indifference when fully confronted by a naked threat to their security.

We think President Kennedy was reflecting the current mood of the American people when he drew the line last week beyond which we will not be pushed without taking up arms against the pushers. Certainly many Americans who served in the European theater in World War II still retain the memory of the horrors inflicted on that continent by the Germans in the 1939-45 war and may have no particular interest in defending the perpetrators of these crimes against humanity from anybody. Recent reflections of the West German mood, with its U.S.-financed prosperity and growing military strength, do not inspire any firm convictions that the German people learned any lessons from their World War II experience except to devote more effort to avoiding defeat. Our British allies have even fewer illusions about the current German temperament, and certainly the French must face the prospect of going to war over Berlin with mixed emotions.

But at this writing, both of these allies are standing firm and joining with this country in drawing a clear and well defined line beyond which any communist advance means a shooting war.

It is ironic that it is Nikita Khrushchev himself who has caused most of this Western solidarity. As long as he played the role of "kindly Uncle Nick," it was difficult for the West to carry a heavy arms burden with any grace. Many of our allies at one time or another sought relief from this load because there appeared to be no real threat on the eastern horizon. But since Mr. Khrushchev has taken to shoe pounding at the United Nations, rocket rattling in almost every major speech and descending to gutter language in his descriptions of Western leaders, the naked brutality of the threat has become clear and the West is now standing firmer than at any time since the United Nations fought the communist bloc in Korea.

The military measures proposed by President Kennedy last week will boost the Fiscal 1962 defense budget to over $47 billion. This will be a heavy but far from crushing burden on the American economy. Much of the new money requested will be devoted to plugging the gaps that have been allowed to develop in our defense structure during the years that we foolishly pursued the mirage that any single weapon or single type of weapon could solve all our defense problems at bargain basement prices.

Certainly the mobility of our armed forces must be increased, as the President proposes, if we are to meet global commitments with sufficient resources in time to be effective against any possible enemy. Another point in the President's proposals that will meet little opposition is the attempt to revitalize the civil defense program on a realistic basis. Here the government has shirked its responsibility in a shameful manner during recent years in failing to provide the American people with realistic facts on the effects of nuclear weapons across their entire spectrum from the relatively low kiloton battlefield type weapons to the multi-megaton infernos carried in ICBM warheads and bomb bays of heavy aircraft. This is another area where secrecy has hurt far more than it could possibly help.

We think, however, that there may be some dangerous illusions generating from the President's emphasis on building limited war capability. There is no question but that this capability must be strengthened to some degree and we must have non-nuclear armaments in our arsenal, but it would be foolish to think we could meet the challenge of full-scale communist aggression with non-nuclear weapons no matter how much our capability in this field is bolstered in the future.

We will never be able to match the Russian hordes on the ground using only conventional weapons. If we are pushed into war, our only hope for victory will lie in a devastating nuclear attack on the aggressor's homeland and sinews of power.

This is a grim prospect. But viewing the Berlin crisis realistically, it is a prospect that must be faced firmly if we are to achieve victory in any struggle that may ensue. We can no longer afford to let our lifeblood be drained slowly from every artery as we did in Korea. If the final test comes, we must commit our best resources to swift and decisive victory.

—Robert Hotz

# ENEMY LACK OF RECONNAISSANCE "PROTECTS" THE ALLIES AT GALLIPOLI

Gallipoli was a test for reconnaissance.

In 1915 the Allies struck at Gallipoli, intending to pierce the vital Dardenelles passage, capture Constantinople, remove Turkey as an effective fighting force and buoy the flagging spirits of their Russian allies. But the Gallipoli landings ran afoul of entrenched masses of determined Turkish troops. The stalemate continued from April through December, 1915. Finally, the Allied high command decided to evacuate . . . quite a trick when opposing trenches were often only ten feet apart! If the Turkish army should have an inkling of the evacuation before completion—if one effective reconnaissance flight were to examine the Allies' disappearing strength, it would mean disaster . . . perhaps the loss of more than 80,000 Allied troops.

But, while Turkish pre-war planning carefully built a large army, the generals ignored the value of reconnaissance capability, thereby allowing an entire army to escape intact. Allied planes, such as the Sopwith Baby, scanned the skies for Turkish and German recon planes. But none flew out to watch the exodus. For five days troops and supplies were discreetly taken off until only 1500 Allied soldiers manned the lines against the entire Turkish army. And finally everyone had gone. Casualties: 2 wounded.

The spirit and fierce resistance of the Turkish army had been manacled by lack of reconnaissance, a costly oversight.

From the beginnings of communities on the face of the earth, reconnaissance has helped shape history. Today CAI's specialty in this area is helping shape history to the advantage of the Free World. Typical of CAI contributions are: **V.I.P.** Visual Integrated Presentation, data display system; **KA-30** the world's most versatile aerial camera; **SOLO** the only electro-optical "available now" guidance system.

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OTHER DIVISIONS: KINTRONIC, CHICAGO AERIAL SURVEY, Franklin Park, Illinois; PACIFIC OPTICAL CORP., Inglewood, Calif.

# WHO'S WHERE

## In the Front Office

**W. C. Hobbs**, a vice president, North American Aviation, Inc., Los Angeles, Calif. Mr. Hobbs continues as assistant to the senior vice president-administration. Also: **William F. Parker**, vice president-program management, North American Aviation's Space and Information Systems Division, Downey, Calif.

**Gail E. Boggs**, a vice president, Page Communications Engineers, Inc., Washington, D. C., a subsidiary of Northrop Corp. Mr. Boggs is the company's director of research and development.

**James J. Lamond**, vice president-flight administration, American Airlines, Inc.

**George F. Farley**, executive vice president and general works manager, Spincraft, Inc., Milwaukee, Wis., and **Robert J. Saggau**, director of sales.

**L. A. Niedfeldt**, vice president-engineering and sales, Brunswick Corp.'s Defense Products Division, Muskegon, Mich.

**George A. Strompl**, a vice president and technical consultant, Davis Industries, Beverly Hills, Calif.

**John W. Boone**, a director, Airpax Electronics, Inc., Ft. Lauderdale, Fla. Mr. Boone is financial vice president and treasurer of Radiation, Inc.

**Richard R. Hydeman**, vice president-marketing and engineering, Taylor Fibre Co., Norristown, Pa. **Frank P. Kelly** succeeds Mr. Hydeman as vice president-manufacturing.

**Dr. Charles J. Breitwieser**, executive vice president and general manager, Cubic Corp., San Diego, Calif.

**J. V. Holdam**, vice president-electronics, Dresser Industries, Inc., Dallas, Tex.

**Richard P. Axten**, secretary, Raytheon Co., Lexington, Mass.

**Col. George Schenkein**, Information Officer, Tactical Air Command, Langley AFB, Va.

**Thomas E. Drumm, Jr.**, administrator of the Business and Defense Services Administration, Department of Commerce.

**Harold E. Felix**, vice president and director of engineering, Midwestern Instruments, Inc., Tulsa, Okla.

**William S. Powell**, president and chief executive officer, Hexcel Products, Inc., Berkeley, Calif.

## Honors and Elections

**Victor E. Carbonara**, retired president of Kollsman Instrument Corp., has received the Thomas L. Thurlow Award for "his outstanding accomplishments in research, invention, design development, and manufacture of air and sea navigation equipment."

**Northrop Corp.'s Nortronics Division** has received the Navy Certificate of Merit for its role in the Polaris Fleet Ballistic Missile Program.

**Donald C. McDonald**, engineering vice president of Sola Electric Co., has been named recipient of the National Electronics Award of Merit for his paper "Nonlinear Techniques for Improving Servo Performance."

*(Continued on page 108)*

# INDUSTRY OBSERVER

▶ Air Force has run 44 of its test pilots through the Dyna-Soar selection program and has rated each in one of three categories—good, excellent or outstanding. Step I suborbital flights will be made with both USAF and NASA test pilots. A contingent of pilots already has been assigned to Boeing to assure their participation from the earliest possible design phase.

**▶ Proposals for a series of about six studies on space rendezvous and related orbital vehicle problems have been requested by Air Force Aeronautical Systems Division. Studies will include space maintenance, launch and alighting techniques for lunar and other aerospace vehicles, and orbital attachment and grappling techniques.**

▶ Navy will buy a tandem two-seat trainer version of the Chance Vought F8U fighter for test and evaluation. The aircraft probably will make its first flight next year.

**▶ Navy has fired an Atlantic Research Arcas sounding rocket from a tube floating in the Pacific off Pt. Mugu as a part of Project Hydra. Three more Arcas launchings are planned. Rockets are fired by electric cable strung from the tube.**

▶ Results of Slomar studies on military satellite support systems are scheduled to be presented to USAF Aeronautical Systems Division next month. Funded Slomar studies are being conducted by Douglas, General Dynamics, Lockheed, Martin, Northrop and General Electric (AW Oct. 24, p. 23).

**▶ Tests of high performance solid fuel rockets at Arnold Engineering Development Center show that while aluminum oxide additives produce a substantial impulse gain at sea level, these engines, such as the Minuteman third stage, don't produce the same impulse gain in tests under high altitude conditions.**

▶ Navy will expand its Naval Tactical Data System to add shore fire support capability to its planned integrated fleet defense weapon system.

**▶ Air Force recently added two supplements to Aerojet's original $4.2-million large segmented solid fuel booster development contract, including $800,000 for firing additional engines, probably 140 in. diameter units, and $600,000 for developing a thrust vector control system for the segmented engines.**

▶ Proposals for NASA's Saturn S-II stage competition were scheduled to be submitted late last week by Douglas, Aerojet, General Dynamics/Astronautics and North American. The S-II stage, which is to be 69 ft. long, 22 ft. in diameter and powered by four Rocketdyne J-2 engines, will have to be built near navigable water so it can be barged to Cape Canaveral.

**▶ Latest approach to silencing the Westland Rotodyne rotor tip jets involves use of a bullet shape mounted in the intake to diffuse air flow. Westland also is exploring design of a new rotor for the Mark 2, Rolls-Royce Tyne-powered model. Each blade would house a number of small combustion chambers along the leading edge, spreading the jet efflux and reducing noise.**

▶ North American Aviation Autoflare automatic flareout computer will be delivered to Boeing in September. The system will be installed with a Boeing-designed autopilot coupler for flight testing in the 707-80 prototype, which is now being used for 727 landing performance tests. Autoflare tests are to begin in December.

**▶ Mercury communications package, to be launched into orbit by a Blue Scout vehicle to test the Mercury tracking and communications network, has encountered problems and its original launch date has slipped several weeks.**

▶ Mitsubishi Heavy Industries Reorganized, Ltd., is expected to receive an order soon to build a rocket research aircraft from the Research and Development Office of the Japanese Self-Defense Agency. The 13-ft. liquid rocket-powered aircraft is to be capable of short term flight at Mach 2. First flight is planned for 1963.

# SILICOLOGY *Studies in Silicones*

HOW THESE TIME-TESTED MATERIALS
CAN WORK FOR YOU

## Do You Control Motion? Restrain, Release It? Silicone Fluids Are Helping Rewrite the Rules

Need a big-muscled spring to fit a pint-size space? You can now get a fluid spring 1/40 the size of an equivalent coil spring. Need a hydraulic shock absorber with a "flat-topped" energy absorption curve between minus 60 and plus 500 deg. F.? You can now get it. Want the two in one unit? You can get that, too.

The common denominator of such high-performance devices is a series of Union Carbide Silicone Fluids. They range in viscosity from 10 centistokes to 100,000, with pour points as low as minus 85 and flash points above 600 deg. F.

**MILLION POUND CAPACITY.** This revolutionary, patented 1,000,000-pound Taylor liquid spring utilizing the precisely known compressibility of Union Carbide Silicone Oil, is said to be the highest force spring ever produced in a single unit. Only a foot in diameter, it could support three of the largest locomotives. On top of it sits Taylor's smallest liquid spring. Beside it is a locomotive coil spring of almost the big spring's size, but providing only 10 tons of force.

### COMPRESSIBILITY PLUS STABILITY

Two of silicone fluids' outstanding properties contribute greatly to their growing usefulness in a variety of hydraulic devices including springs, shock absorbers, torque convertors, dash pots, valve lifters, many more. These are compressibility—the highest known for polymeric fluids—combined with stability at temperature extremes.

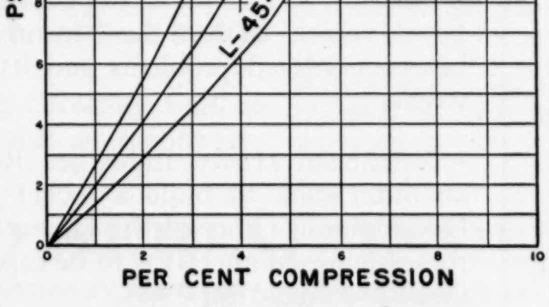
The per cent compressibility of Union Carbide L-45 and L-527 Silicone Fluids, compared to conventional mineral oil, is shown in the accompanying chart. The viscosity temperature coefficient $\left(1-\frac{\text{V210°F.}}{\text{V100°F.}}\right)$ for L-45 with nominal viscosity of 100 ctsk. is 0.63.

### NAME YOUR OWN SPRING RATE

Taylor Devices, Inc., of North Tonawanda, N. Y., is one of the companies adapting these highly useful qualities to hydraulic equipment. In tension and compression devices, for example, using a stepped tubular piston design and L-45 fluid, they achieve virtually any desired spring rate and force, within a compact, structurally stable mechanism.

Again, in spring-shock absorbers where high mechanical energy is converted to heat energy, Taylor Devices find Union Carbide Silicone Fluids greatly extend the useful work range of the units.

Among the jobs such devices are performing are: Scram-rod cushions in nuclear reactors, taking impact loads on aircraft arresting hooks, cushioning aircraft radar antennas. In addition, they arrest circuit breaker mechanisms at interruption, stop rolls of paper on paper machines, and control feed rate of electrodes on electric furnaces.



Compressibility of Union Carbide Silicone Fluids vs. Mineral Oil

### R AND D TO HELP YOU

If you design hydraulic equipment for tough duty, your Union Carbide Silicones Man has a wealth of technical know-how on the ways Silicone Fluids can help you obtain outstanding performance. Behind him are the vast experience and research of Union Carbide Corporation in virtually every field of industry.

We invite you to send at once for our comprehensive "Design File" on Union Carbide Silicone Fluids for Mechanical Applications. It gives you in one handy package just about all you need to know about silicone fluids for your design requirements. Mail the coupon today.

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# Washington Roundup

## U.S.-Soviet Bilateral

**Negotiations between the U. S. and Soviet Russia on a bilateral air transport agreement now are expected to reach an early climax—possibly within a week.** Chances of reaching some accord on a reciprocal New York-Moscow route appear to be about 50-50. Principal area of disagreement lies in the technical field.

**As early as last February, the U. S. stated its position that standards set by the International Civil Aviation Organization** and the International Air Transport Assn. must serve as guidelines in formulating an agreement. Russia's counter-proposals on these issues weren't handed to the U. S. until the opening day of negotiations. Discussions began as soon as the Russian proposals were translated, but the U. S. has met with unanticipated opposition.

**Commerce Department has recommended to the White House that measures be taken to expand the use of air travel by assessing the possibilities of reducing air fares to generate new markets.** It also has urged that the machinery of the Railway Labor Act be studied to see how massive breakdowns in airline labor-management relations can be corrected. Commerce told the White House it is concerned over strikes, strike threats, walkouts and work stoppages which it said have "vastly" inconvenienced air travelers.

## Patented Approach

**National Aeronautics and Space Council is trying to work out a government policy on patents for inventions developed under the communications satellite program (see p. 25).** Edward C. Welsh, the council's executive secretary, has just begun the study, and he plans to use the same technique that resulted in unanimous agreement among federal agencies affected by the recent presidential policy pronouncements on the lunar landing program and the communications satellite.

**Welsh will call everyone involved into the same room at the beginning and keep calling them back until agreement is reached.** He will meet soon with representatives of the agencies most immediately concerned—National Aeronautics and Space Administration, Commerce and Justice Departments.

**New congressional study to determine who should do what in the U. S. effort to land men on the moon is about to get under way in the House space committee.** First step is a staff review blocking out the most productive areas of inquiry for space committee members. The objective is to take a broad look at the nation's capabilities, with emphasis on how the lunar program can best be managed. This would be the first full-fledged congressional study of the program since President Kennedy presented his lunar plan late last May.

## 'Spy' Satellites

**Since Sputnik I was launched almost four years ago, there has been no settlement of two key space age legal questions—how high a nation's sovereign air space extends** and whether earth satellites, whatever their mission, violate these zones.

**Soviet Russia's military publication Krasnaya Zvezda has reopened the argument by insisting that USAF's Midas III and the civilian Tiros III**, both launched July 12 and both crossing Soviet territory, are spy vehicles similar to the Lockheed U-2 aircraft, adding: "A spy is a spy no matter at what height it flies. The flights of the satellite spies over foreign territory are acts of aggression." Since Russia does not admit using its satellites for any kind of surveillance, it gains at least a propaganda advantage by limiting its protests to vehicles with this mission.

**Israel's launching of a solid-fueled research rocket and subsequent Israeli comments relating it to "defense" problems continue to have repercussions.** Following a discussion about the way in which the test was revealed to the public, the Israeli cabinet decided any future tests of political and international significance should be submitted for prior approval to a ministerial committee, which apparently will be appointed at the next cabinet session.

**The United Arab Republic said Israel's rulers "have a right to change the name of the French missile 'Monique 5'** and to give it the Hebrew name 'Shavit II'" but said Israel "overstepped the limit" when it criticized the UAR for trying to buy rockets from U. S. firms.

## Mercury Reactions

**Most of the telegrams that showered on Astronaut Virgil Grissom after his Mercury flight (see p. 30) expressed sincere congratulations or prayerful thanks** for his safe recovery. But one, signed "the gang at the Majestic [cafeteria]" in New York, said simply "Attaboy, Dad." East German communist radio broadcasters took a different view, calling the flight another of "the utterly inadequate U. S. rocket tests in which human lives are risked recklessly for the sake of a paltry gain of prestige."

**Because the three-man National Aeronautics and Space Administration-Defense Department Executive Committee for Joint Lunar Study (see p. 28)** has no chairman and each man has an equal vote, the group is known around Cape Canaveral as "the troika."

—Washington Staff

# Kennedy Asks More Aircraft, Missile Funds

## $1.3 billion requested for Fiscal 1962 procurement; total defense budget is increased to $47.5 billion.

By George C. Wilson

**Washington**—President Kennedy is seeking from Congress—and will undoubtedly get—an extra $1.3 billion this fiscal year for more manned aircraft and missiles as part of the U. S. buildup to meet a Berlin crisis.

The Administration wants to spend $361 million to keep older aircraft in service and to activate reserve air units, while $558.7 million is planned for buying new aircraft. Although the President did not ask for more money to buy bombers, Congress is expected to appropriate it anyway.

For missiles, the President wants $357.8 million for procurement and an additional $10 million to improve the Tartars and Terriers on Navy ships.

The $1.3 billion for aircraft and missiles was part of the total $3.45 billion additional the President requested to help strengthen the non-nuclear power of the armed forces.

The new request increases the total Fiscal 1962 defense budget request to $47,506,113,000.

President Kennedy told the nation last week that the extra defense money is needed "to make clear our determination and ability to defend our rights at all costs and to meet all levels of aggressor pressures with whatever levels of force are required."

### Fast Congressional Action

Secretary of Defense Robert S. McNamara and other Pentagon officials detailed the money requests before a closed session of the Senate Appropriations Defense Department Subcommittee. Acting Chairman A. Willis Robertson (D.-Va.) plans to clear the defense bill with the additions for floor action this week.

The House also is moving quickly to give the President the money he requested.

In addition to asking for more procurement and operation and maintenance funds for Fiscal 1962, President Kennedy asked Congress for more money and authority to increase the size of the Air Force, Army and Navy. He requested $751 million additional for military personnel to be divided among the services this way: Air Force, $164 million; Army, $495 million, Navy, $92 million.

This would finance these increases in manpower: Air Force, 63,327; Army, 133,000, Navy, 29,000.

President Kennedy also submitted draft legislation to Congress to empower him to activate up to 250,000 reservists this fiscal year and requested Congress to authorize the secretary of defense to extend enlistments up to 12 months. Further, he said draft calls would be "doubled and tripled in the coming months."

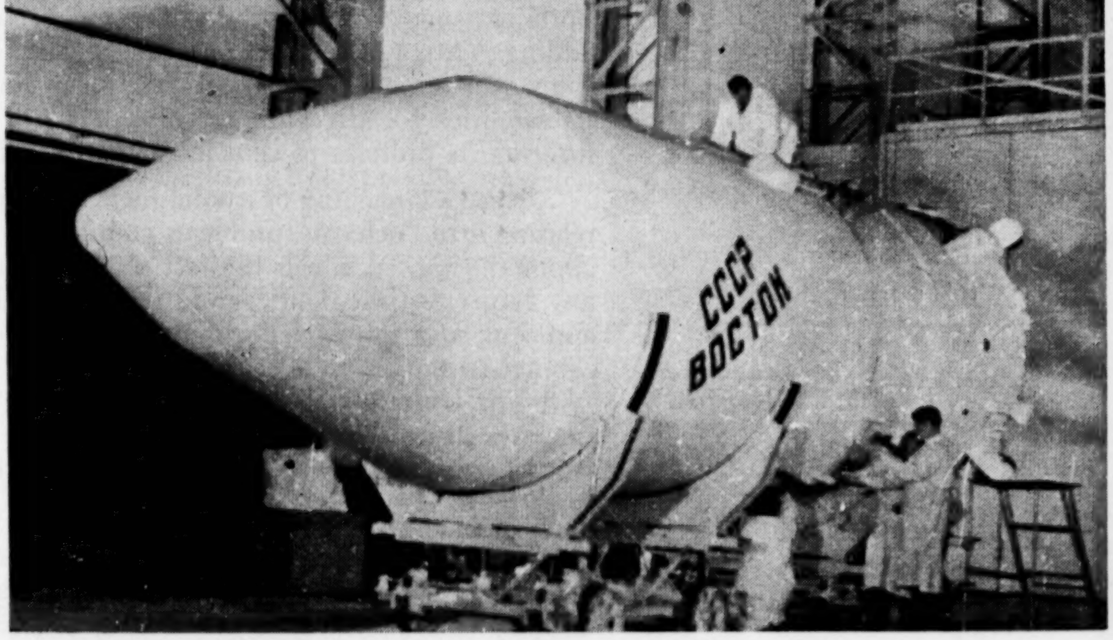
No new money was requested for research and development. But the Senate appropriations subcommittee is expected to provide additional millions for stepped up development of the B-70. The Kennedy budget contains $220 million for the B-70, but Air Force Chief of Staff Gen. Curtis E. LeMay recommended that the Senate appropriations subcommittee provide $448 million (AW July 24, p. 22).

### Biggest Increase

The biggest single increase among the new requests was for procurement —$1.75 billion—with the Army slated to get $552 million for equipment and missiles and the Navy $543.6 million for aircraft and missiles. The Air Force is to get $220.3 million of the procurement funds for aircraft and missiles.

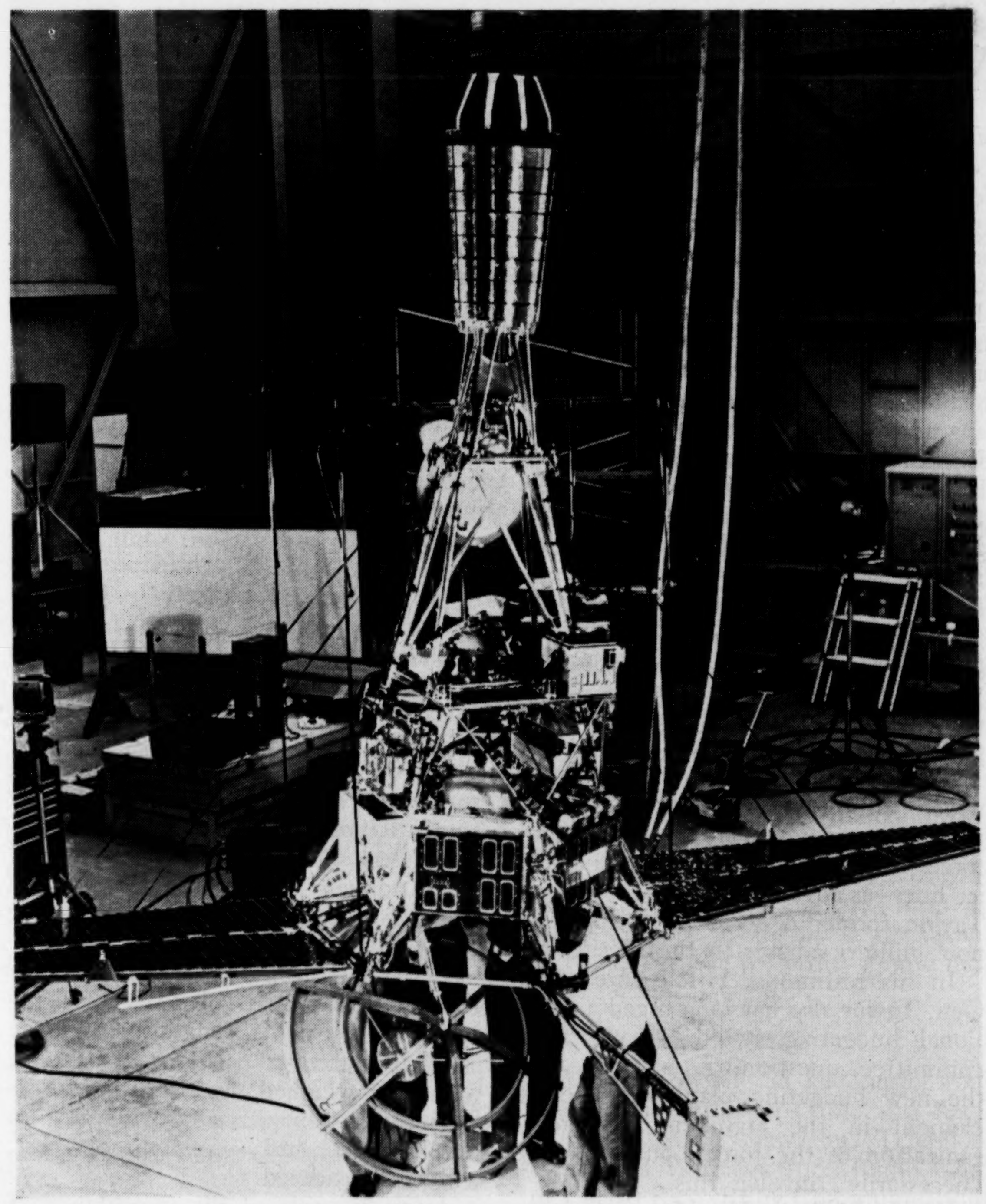
Here is a breakdown of the new funds requested by President Kennedy for aircraft and missiles, as well as some of the justifications given by McNamara in a statement released by the Senate appropriations subcommittee:

- **Air Force**—Requested $241 million for such aircraft as the Republic F-105D supersonic all-weather fighter-bomber and the Lockheed C-130B and E transports. Although McNamara specifically mentioned these airplanes as being on the procurement list, he did not rule out buying others. He said the Defense Department also plans to buy additional tooling and long leadtime components for the C-130E "so that the planned peak production rate could be raised considerably." An additional $62 million is sought for missiles, including "a large number" of Sidewinders and Bullpups for tactical fighters and Falcon air-to-air missiles for interceptors.
- **Army**—Requested $36.7 million for aircraft, including Bell Iroquois and Sioux helicopters and Beech Seminole utility aircraft. For missiles, the Defense Department asked $19.2 million to provide more Honest Johns and nonnuclear warheads for them. In addition, $14.6 million is sought for nonnuclear Nike Hercules warheads and Hawk missiles for tactical air defense.
- **Navy**—Requested $281 million for



**Russian Film Shows Vostok-Labeled Capsule**

**Capsule identified by lettering as the Soviet Vostok space ship is photographed in a Russian documentary film, "First Trip to the Stars," initially shown in Moscow on the day of the Tushino air show. This configuration is somewhat like the one carried by helicopter at the show (AW July 17, p. 30) but lacks the circular housing at the stern. Aft section of this capsule is similar in size to the Russian Mechta capsule (AW July 13, 1959, p. 117) and in having a wide-ridged metal reinforcing ring (visible behind the white-coated technicians) in the same relative position.**



## Ranger Prepared for Lunar Exploration

**Ranger spacecraft, a forerunner of later vehicles in the series which will rough-land instrumented packages on the moon, will be launched into space by an Atlas-Agena B. Gold plate, white paint and polished aluminum are used on the Jet Propulsion Laboratory Ranger I to control its temperature in the space environment (AW July 24, p. 39).**

additional aircraft, including Douglas A4D-2N attack airplanes, Chance-Vought F8U-2N and McDonnell F4H-1 fighters, plus patrol, search and transport aircraft and helicopters. Defense Department also seeks $262 million for tactical and air defense missiles—including Sidewinder, Sparrow, Tartar, Terrier and Talos.

The Kennedy Administration requested $743 million more for military operations and maintenance, with a sizable slice to be used to keep more Strategic Air Command bombers on a 15-min. ground alert. The Administration asked for $24 million to ensure that half the Boeing B-47 and B-52 bombers are kept on this type of alert and $45 million to retain B-47 wings and their tankers originally slated to be phased out of service this fiscal year.

The twin actions, McNamara said, "will provide a significant increase" in the number of B-47s on 15-min. ground alert at the end of Fiscal 1962.

As a backup to SAGE, President Kennedy requested $17 million additional for personnel to provide more manual control of interceptor aircraft at radar sites.

McNamara said "if we are to have the capability to move these additional combat forces [requested by the President] promptly to wherever they may be needed, we must concurrently increase our sea and air lift." The President requested money to reactivate troop transports, amphibious ships and to retain "several squadrons" of C-118s slated to be phased out of service in Fiscal 1962.

He said "we would also be prepared to order to active duty Boeing C-97 squadrons from the Air National Guard and C-124 squadrons from the Air Force Reserve." He said retaining the C-118s and activating the reserves necessitated the President's new request for $72 million.

### Carrier Reactivated

The Navy plans to activate another aircraft carrier as well as several fleet-support ships. The increased activity will necessitate spending $49 million more than contemplated for overhauling Navy airplanes and $10 million more for improving such ship-based defense missiles as the Tartar and Terrier.

To provide the tactical air support for the increased ground forces, McNamara said the Air Force would retain some of its light-bomber, reconnaissance and tactical fighter squadrons scheduled to be phased out of service. This would cost $14 million, he said. The Administration requested an additional $154 million so the Air Force could, "if need be," activate Air National Guard squadrons and tactical aircraft control groups. An extra $3 million was asked to maintain the tactical air control system in Europe.

President Kennedy requested an extra $207.6 million for the Defense Department's civil defense program. McNamara said in a nuclear attack "several tens of millions" might be killed, "but a comparatively modest program can provide a great deal of protection for people who are not close to points of detonation." He said the program's objective is to supply enough fallout shelters "to provide reasonably adequate protection for about one-quarter of the population."

Of the $207.6 million sought, $93 million would go for marking shelters in existing buildings; $10 million for modifying existing shelters; $7.5 million for new shelters in new federal buildings; $58.8 million for survival supplies; $15.5 million for a new household warning system and improvement of existing systems; $9.3 million for radiological detection equipment, and $13.5 million for research and development.

Along with these specific money requests, President Kennedy asked Congress to add a section to the Defense Department appropriations bill empowering the secretary of defense to transfer up to 5% of the money in one budget account to another. This authority, McNamara said, "would provide much needed flexibility." He said the reprograming would be subject to the approval of the congressional appropriations committees. The Administration also asked Congress to delete the provision in the House-passed appropriation bill limiting the number of officers who can receive flight pay. McNamara said it is "impossible for us at this time" to estimate the number of officers who will be eligible to receive flight pay.

# New Budgeting Plan Shifts Rivalry From Services to Weapon Systems

By Katherine Johnsen

**Washington**—Competition for defense dollars will shift from service vs. service to weapon vs. weapon rivalry under Defense Department's new program for functional budgeting, according to Assistant Secretary of Defense-Comptroller Charles H. Hitch.

Testifying last week before the Senate Subcommittee on National Policy Machinery, Hitch said that greater selectivity among weapon systems to accomplish comparable missions is the objective of the new program (AW July 24, p. 34) and that this will be a "substitute" for the dollar ceilings imposed on the services in the past.

The new budgeting system is being widely interpreted as a first major step toward a reorganization of military forces along functional rather than service lines—as advocated by Gen. Maxwell Taylor, former Army chief of staff and now military adviser to the President.

In his testimony, Hitch noted that Gen. Taylor also has long urged a functional budgeting system. Under subcommittee questioning, he said that the new budgeting plan "may be an element in the argument" for reorganization of the forces, but does not "necessarily" involve this.

W. J. McNeil, Hitch's predecessor as Defense comptroller, followed him as a witness last week before the subcommittee. McNeil said that the military reorganization would automatically follow from the new budget system because "management or command structures follow the money." He opposed the new plan on the grounds that it would arbitrarily divide—and separate—forces according to weapon systems.

McNeil commented that, for example, "in the formulation of national policy there are times when the allocation by areas is considered just as important as comparison by weapon systems."

During the hearing, Sen. Henry M. Jackson (D.-Wash.), chairman of the subcommittee, noted that in the past the Navy has been reluctant to allocate funds for the Polaris program because this would squeeze out other Navy programs. Under the new package budgeting system, Hitch noted, Polaris would be in direct competition with other strategic forces, rather than with other Navy programs.

Long-range funding—if possible for the entire life span of a weapon system from research through obsolescence—will be used to achieve selectivity, with cost weighed against military effectiveness. Operating cost, as well as development and procurement cost, will be considered.

As an example of the importance of operating cost, Hitch pointed out that the five-year operating cost of a B-52 wing approximates the investment cost of $500 million.

Past Defense budgeting on a year-to-year basis, Hitch told the subcommittee, "did not facilitate the relating of costs to weapon systems, tasks, and missions. Its time horizon was too limited. It did not disclose the full time-phased costs of proposed programs. And it did not provide the data needed to assess properly the cost and effectiveness of alternative programs."

The new budget will be divided into seven major categories, called "program packages": Central War Offensive Forces; Central War Defensive Forces and Civil Defense; General Purpose Forces; Sealift-Airlift; Reserve and National Guard; Research, Development, Space; and Service-wide Support.

Defense expects to complete a program for the next five years in September. In October and November, the Fiscal 1963 budget implementing the first phase will be prepared.

The timetable established for each of the services to submit to the secretary of defense "program elements" to be included in each "program package" runs to Aug. 28. The elements are to be funded for a minimum five years, and, if possible, through 1970. No dollar ceilings were assigned.

**Air Force and Navy** already have met the July 3 deadline for submissions to the war offensive package, recommending 3,900 ballistic missiles ready for firing from the continental U. S. and submarines by 1967. The next deadline is Aug. 21, for submissions to the central war defensive package.

Hitch reported that Defense will continue to draw budgets along the old lines—with such categories as "personnel," "procurement," "research and development" and sub-categories for each of the three services. Two budgets, slicing the defense dollar in two different ways, will be submitted next year to Congress, he said.

In addition to submitting costs by appropriation, obligation, and expenditure for the old-type budget, the services will be required to submit three new categories of costs for each program element:

- **Research and development,** including all facilities, supply, and personnel costs applicable to a weapon system.
- **Operating costs.** A major advantage of the new Defense budgeting plan, Hitch emphasized, is that annual budgets in the future may be drawn "rather quickly" because "there should be no need for a hectic and hurried 'program' review crammed into a few weeks."
- **Investment costs,** including all costs to bring a weapon from the development phase to the operational phase—training, bases, installations, hardware.

## FAI Certifies Astronaut Shots

**Paris—Federation Aeronautique International announced that its space committee had completed investigation of initial Soviet and U. S. space shots and the following records are now official:**

**On Apr. 12, 1961, Soviet Astronaut Yuri A. Gagarin established these three FAI space records: length of earth orbital flight, 108 min.; highest altitude reached on earth orbital flight, 327 km.; largest volume lifted during earth orbital flight at maximum altitude of 327 km., 4,725 kg.**

**On May 5, 1961, U. S. Astronaut Alan B. Shepard, Jr., established these two FAI space records: altitude reached without entering earth orbital flight, 186.3 km.; largest volume lifted without entering earth orbital flight, 1,832.6 kg.**

**An FAI announcement noted that these five space records were the first of their type and reflected entry into a new region for FAI. The records were approved by FAI's 18-member space committee established in October, 1960. This committee, headed by Dr. D. J. Lyons, Great Britain, approved the new records at a special meeting July 18.**

**Committee also is revising FAI bylaws in an attempt to establish closer FAI control over record attempts. Three Soviet members of FAI's space committee, for example, agreed in principle that an FAI observer should be on hand for future Soviet space shots. Observers, however, pointed out that FAI had no definite assurance that the Soviet Union would carry out this agreement.**

**Jacques Allez, FAI president and member of FAI's space committee, was on hand for the Shepard shot.**

**FAI space committee, in addition to Dr. Lyons as chairman, has R. B. Dillaway, of the U. S. as vice-chairman and Col. Genty, of France, as committee secretary.**

# Kennedy Sets Commercial Satellite Policy

**Washington**—President Kennedy set down the ground rules last week for U.S. operation of a communications satellite system, while the National Aeronautics and Space Administration advanced the research phase by agreeing to launch two experimental satellites for the American Telephone and Telegraph Co.

These top-level policy decisions were accompanied by Federal Communications Commission action directing a committee of international carriers to recommend who should own and operate the communications satellite system. This ad hoc carrier committee, composed of 10 international carriers, is to meet Aug. 3 and submit its report by Oct. 13.

At the same time, FCC dismissed petitions by General Electric Co. and General Telephone and Electronics Corp. to broaden the ownership of the communications satellite system beyond international carriers. The FCC order did not rule out broadening ownership later, however, when policy discussions were further along.

President Kennedy's policy statements on communications satellites are the first ever issued publicly by any head of state and are designed to guide future negotiations and decisions by all U.S. government agencies—particularly the FCC, Justice Department, NASA and State Department.

## Public Interest

"The primary guideline for the preparation of such recommendations," President Kennedy said, "was that public interest objectives be given the highest priority. I again invite all nations to participate in a communications satellite system in the interest of world peace and closer brotherhood among peoples throughout the world."

He added that the question of who will operate the communications satellite system has not been decided, observing that "no arrangements between the government and private industry contain any commitments as to an operational system."

The President said "private ownership and operation of the U.S. portion of the system is favored" provided the owners and operators meet his policy requirements. The policy statements were evolved during discussions which began June 15 among the members of the National Aeronautics and Space Council. Vice President Lyndon Johnson, council chairman, and Executive Secretary Edward C. Welsh coordinated the effort which produced the policy report.

Welsh told Aviation Week the objective was to provide ground rules "so reasonable" that everyone could live within them and no future President, regardless of party, would feel compelled to revamp them. He said initial reaction to the policy statements was "very favorable."

The eight policy statements regarding ownership and operation of the communications satellite system stipulate that: (1) "New and expanded international communications services" are to be made available "at the earliest practical date;" (2) the system is to be made "global in coverage . . . including service where individual portions of the coverage are not profitable;" (3) opportunities for foreign participation are to be provided through ownership or otherwise; (4) "non-discriminatory use of and equitable access to the system by present and future authorized communications carriers" is to be assured; (5) there is to be "effective competition, such as competitive bidding, in the acquisition of equipment. . . ." (6) ownership or control should assure "maximum possible competition;" (7) there is to be "full compliance" with anti-trust laws and regulatory controls, (8) an economical system is to be developed, "the benefits of which will be reflected in overseas communications rates."

Welsh said the eighth policy statement means that profits from the satellite system should be used to reduce rates on other communication channels.

These were the eight policy statements on U. S. government responsibilities regarding the communications satellite system, in addition to its regulatory role: (1) "conduct and encourage" research to advance the system; (2) supervise international agreements and negotiations; (3) "control all launching of U. S. spacecraft;" (4) establish separate communications satellite systems if the commercial ones did not fulfill "unique government needs;" (5) assure the effective use of the radio-frequency spectrum;" (6) be able to turn off the satellites; (7) help "newly developing countries" get into the global communications system; (8) study with other countries "the most constructive role" for the United Nations to play in the system.

Welsh said the U. S. must control satellite launchings because "we can't have private companies shooting up rockets at will. This could start a war." He said there is special interest in giving Africa and South America technical help so they can participate in the global communications system at an early date. As for the UN's role, he said sessions of the General Assembly might be transmitted all over the world by the system.

NASA Administrator James E. Webb told the House Interstate and Foreign Commerce Committee last week that he interprets the President's policy statements to mean that NASA should "provide leadership and direction for the extensive research and development effort" needed to establish the communications satellite system "at the earliest possible date." In this connection, Webb said, NASA will provide AT&T with "the facilities for launching and tracking at least two of these satellites during calendar year 1962."

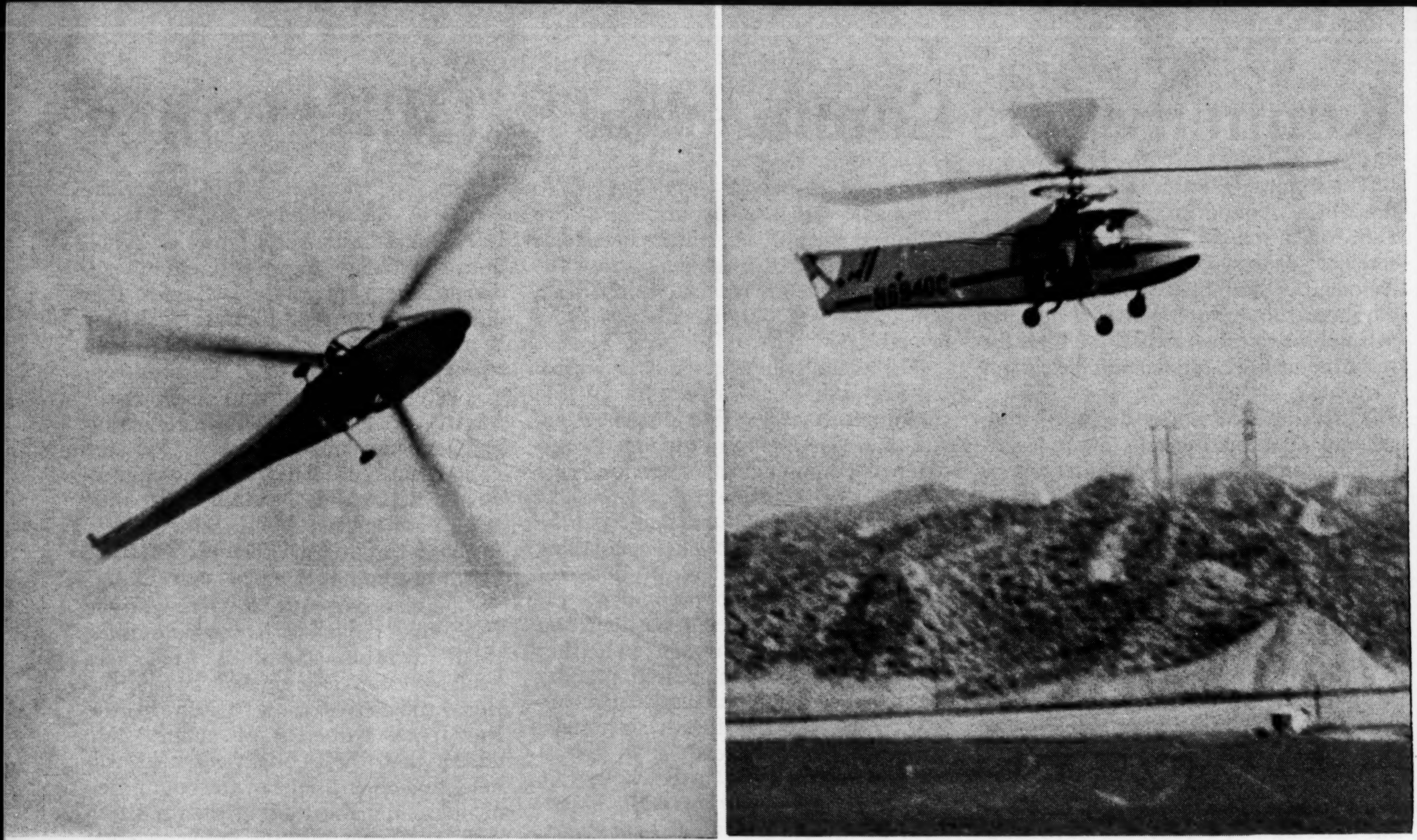
Chairman Newton N. Minow of the FCC told the same House committee that "any future action" the FCC takes "will of course be guided by the national objectives as set forth in the President's statement of policy." He added that these objectives also will help guide discussions of the committee of international carriers at their meeting Aug. 3. Minow said the proposals coming out of that meeting "will form the basis" for FCC decisions on the ownership and operation of the communications satellite system.

## Ad Hoc Committee

Members of the ad hoc carrier committee are: American Cable and Radio Corp., AT&T, Hawaiian Telephone Co., Press Wireless, Inc., Radio Corp. of Puerto Rico, RCA Communications, Inc., South Puerto Rico Sugar Co., Tropical Radio Telegraph Co., U. S.-Liberia Radio Corp. and Western Union Telegraph Co. The FCC notice inviting these carriers to the meeting directs them in their report to state how much capital each carrier could contribute to the ownership system.

The meeting of the carriers evidently figured in the FCC's denial of General Electric and General Telephone and Electronics Corp. petitions regarding the ownership of the communications satellite system. GE sought to make ownership in the system open to all, while General Telephone asked the FCC to include domestic carriers or also consider General Telephone an international carrier. The petitions followed the FCC First Report of May 24 which concluded that a system owned by international carriers appeared to be most practical.

The FCC order said the two companies "misconstrue the real import" of the First Report by asking that it be modified. The FCC said the First Report did not set forth fixed policy but was instead a preliminary report still subject to change.



**LOCKHEED'S** helicopter is designed to test rigid rotor concept. Flight tests are being made 55 mi. north of Los Angeles.

# First Photos Show Lockheed's Helicopter

By William S. Reed

Los Angeles—First photos of Lockheed Aircraft Corp.'s flying testbed helicopter in flight in Rye Canyon near Castaic Junction 55 mi. north of here provide first design details of the company-funded project.

Commenting on the helicopter, Lockheed said that it is "the first to succeed in using the inherently stable gyro effect of the rotor blades to simplify control." The helicopter is inherently stable, Lockheed claims, and has resulting ease of handling together with mechanical simplicity.

## Design Principle

Design principle used is a rigid rotor which accounts for claims of reduced manufacturing costs and lower maintenance.

The blades are non-articulated eliminating the familiar "slapping" noise produced by most helicopters in flight. The noise was absent during the flights observed by Aviation Week.

The Lockheed helicopter appears to be about 23 ft. in length and is painted silver with a red strip running lengthwise along the fuselage. Its three-bladed rotor has a diameter of about 30 ft. A two-bladed anti-torque rotor of 5.5 ft. diameter is protected from ground contact by the deep aft fuselage structure. Power is supplied by an engine in what appears to be the 300- to 350-hp. class.

Two pilots are carried in side-by-side seats with visibility provided by a windshield over a solid nose. A tricycle landing gear supports the helicopter on the ground.

Most unusual feature of the aircraft is a large ring about 4.5 ft. in diameter positioned just above the fuselage and below the rotor. This ring rotates with the rotor and has three arms extending to each of the blades. The presence of the ring appears to be an important component for the gyroscopic principle in development of the rigid rotor concept.

In operation, the Lockheed helicopter seemed to be capable of rapid forward flight and smooth transition to slow flight. It was brought to a hover with little of the shake and shudder exhibited by some other rotary-winged vehicles. No large addition of power was heard as the machine came to hovering flight as is the case with conventionally controlled helicopters.

## Flying Testbed

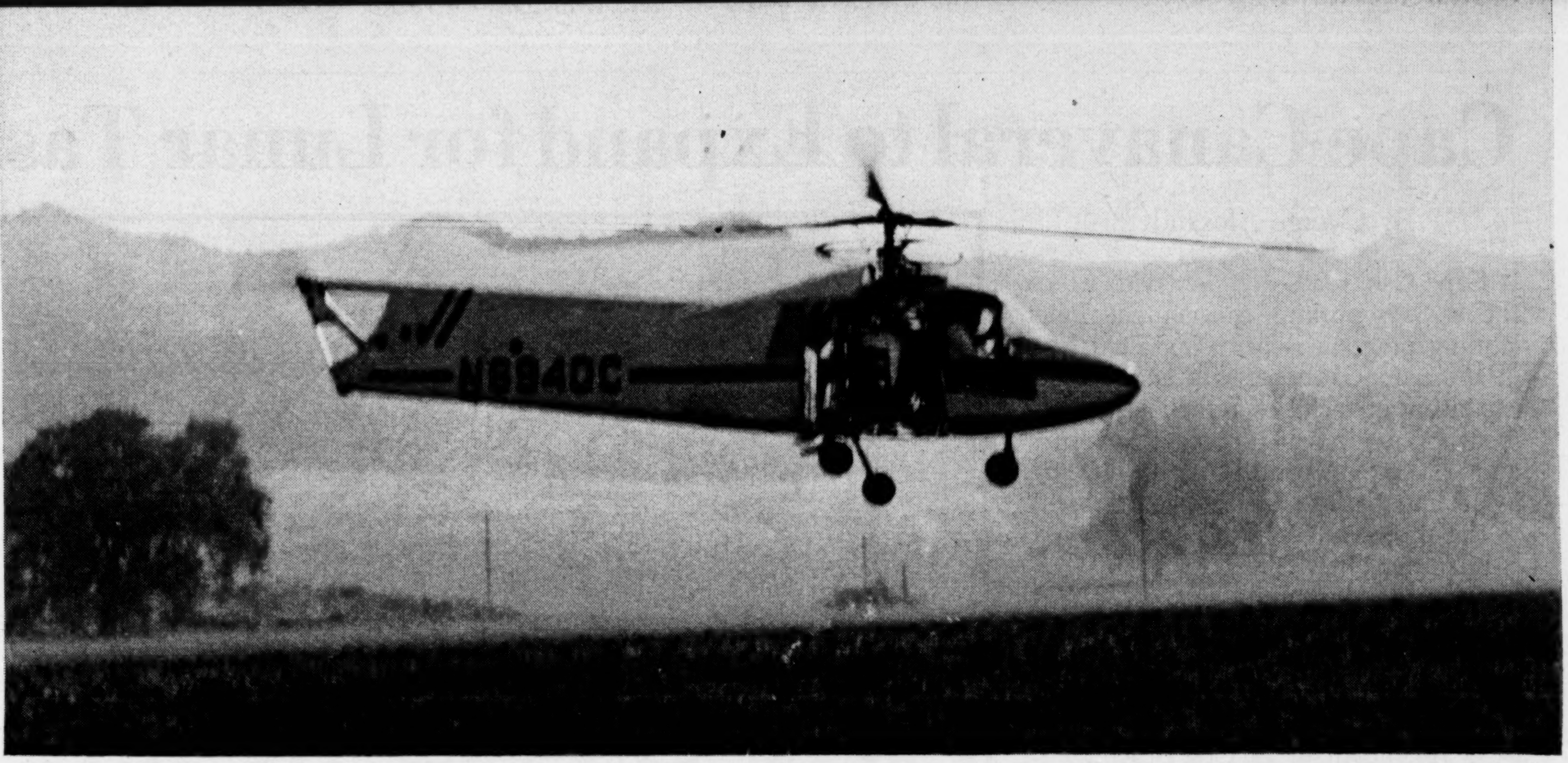
Lockheed pointed out that the helicopter is not a production or prototype item. It is a flying testbed which has neither a production configuration nor powerplant. The engine used was selected for horsepower and reliability and is not necessarily the one best suited for the machine. Principle of the control system is adaptable to both piston and turbine powerplants and can be used on both small and large helicopters with equally satisfactory results.

Vice Adm. John T. Hayward, deputy chief of naval operations-development, recently testified before a subcommittee of the House appropriations committee that the Lockheed helicopter is "a tremendous advance. . . . It looks to me like this is the first real step forward in the helicopter business toward bringing about a cut in cost, maintenance, to improve reliability and to make it easy to train pilots." He further said it is the answer to what is new in the helicopter field.

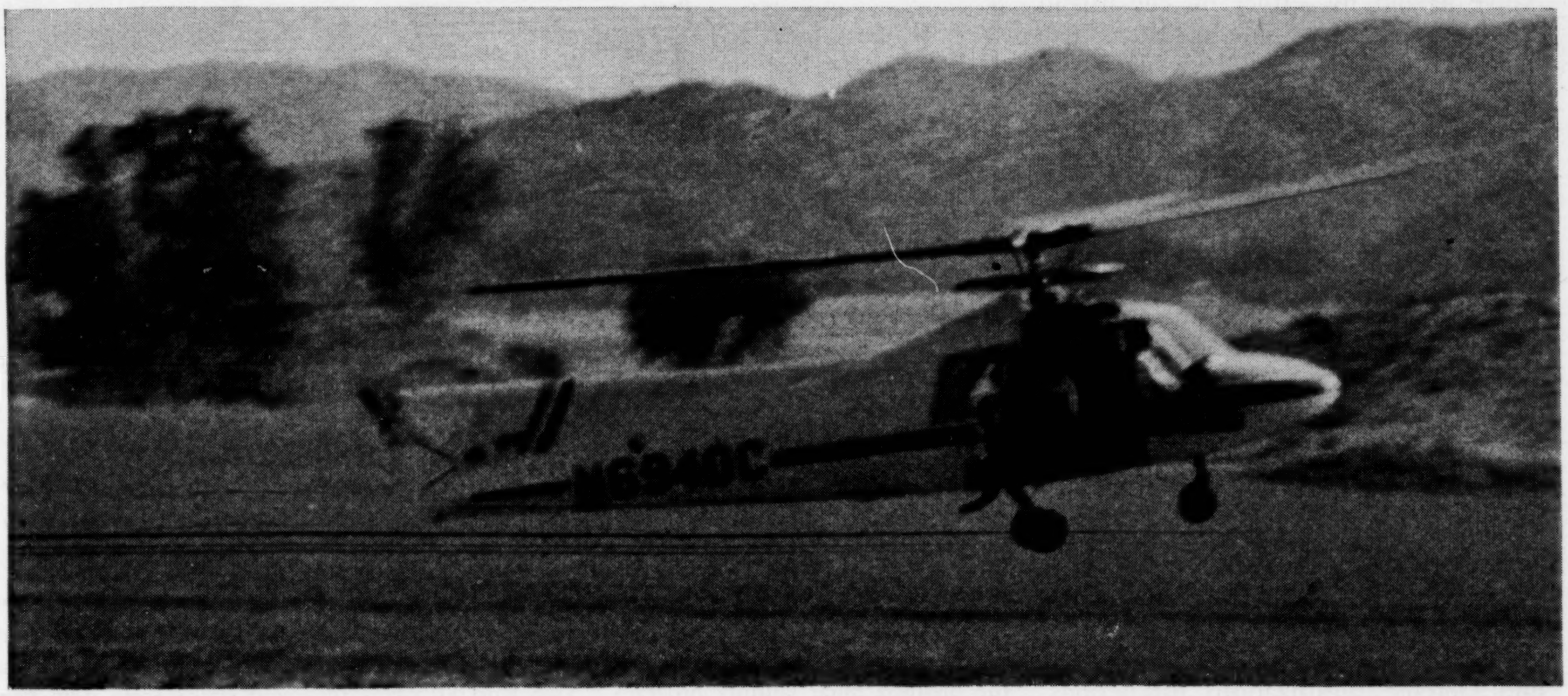
## LOH Entry

Lockheed entered the helicopter in the recent light observation helicopter competition but did not win (AW May 29, p. 27). At the time of Adm. Hayward's testimony, serious consideration was being given to a joint Army-Navy-funded project to further develop the helicopter concept in the event Lockheed did not win the LOH competition.

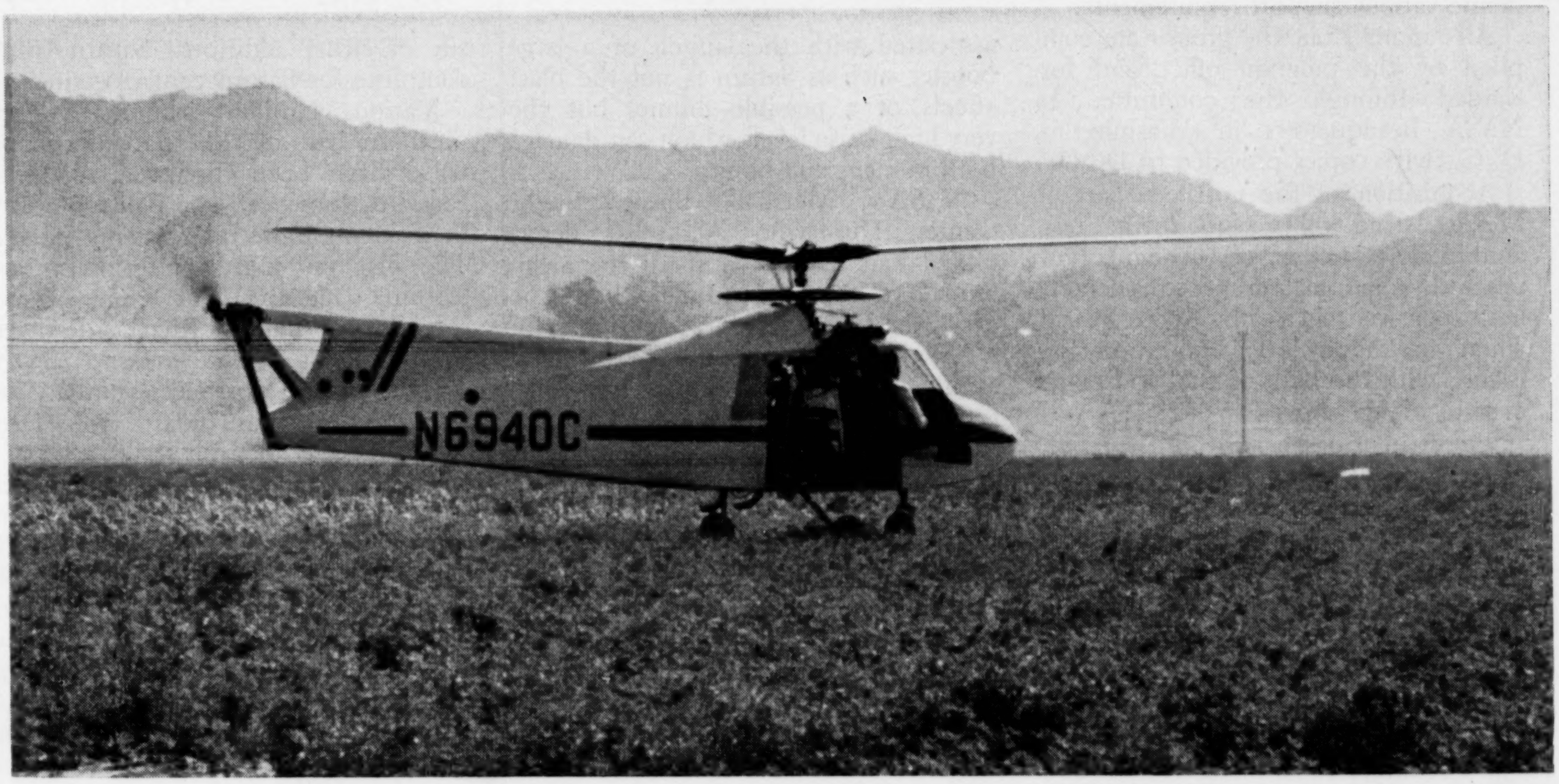
An operational military aircraft could be developed by January, 1964, if such a program were funded. However, Lockheed has not been awarded such a contract and development still is being company-funded



**TAIL ROTOR** is protected from ground contact by deep aft fuselage structure. Helicopter has two side-by-side seats.

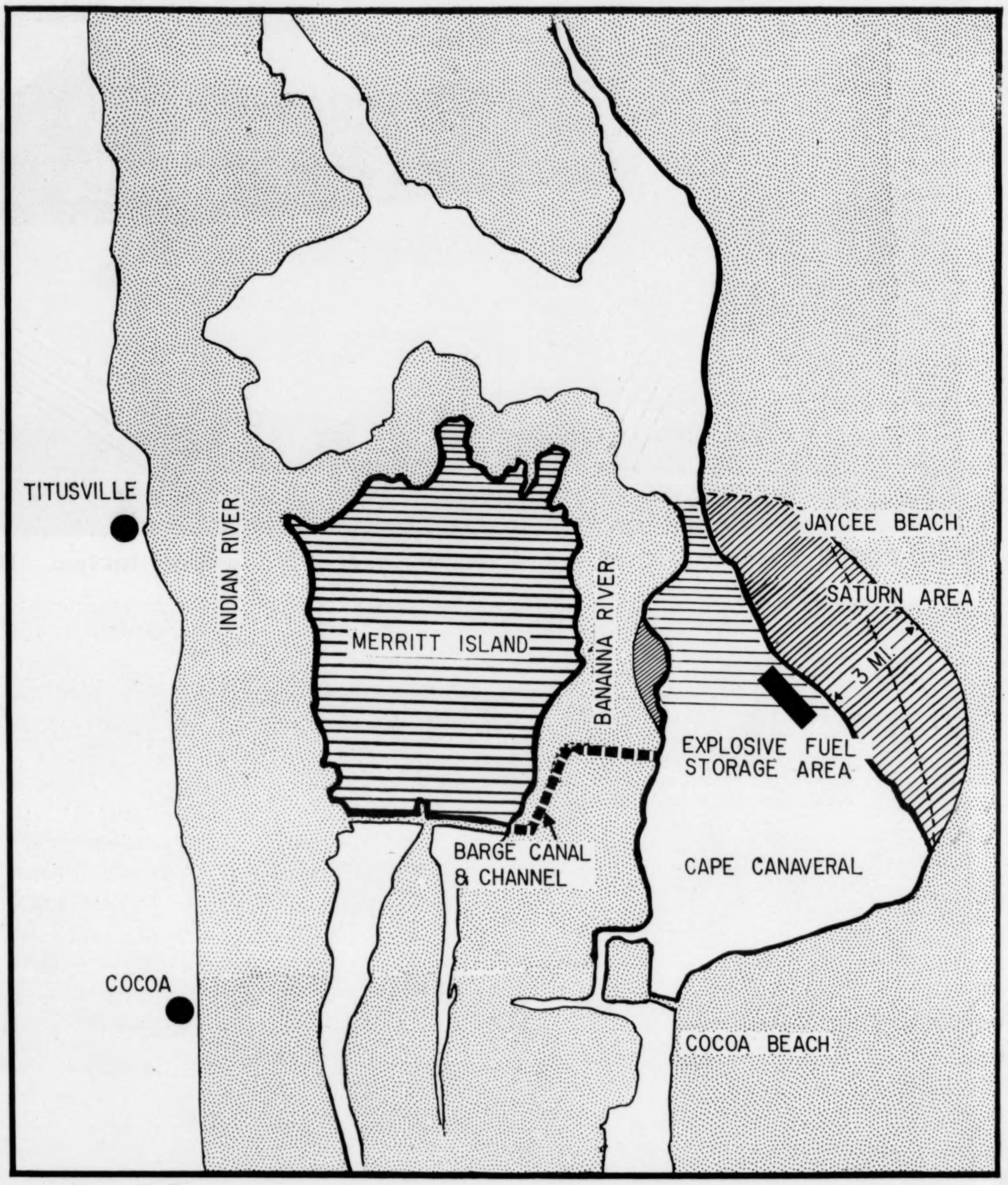


**RING** between rotor and fuselage top has three arms extending to each of the rotor blades and rotates with rotor.



# Cape Canaveral to Expand for Lunar Task

By George Alexander



**NORTHERN PART** of Merritt Island and a 9-mi. strip of beach north of the present Cape Canaveral boundary (horizontal stripes) will be added to the missile test center to support the manned lunar landing program. Two land fill plans (diagonal stripes) are now being considered to provide additional launch area.

**Cape Canaveral**—Urgency with which the U. S. is pushing the manned lunar landing program is being reflected here in the planned increase in acreage, the expansion of facilities and the establishment of a joint National Aeronautics and Space Administration-Defense Department office, all in direct support of the project.

First step, now under way, is the acquisition of the upper part of Merritt Island, north of the barge canal which cuts across the island (see map). Second step, still in planning, is the extension of the Cape's present northern boundary 9 mi. north of JayCee Beach.

Third step, also in planning, will involve a land fill, either on the inland side or the ocean side of the Cape. Pan American Guided Missiles Division, support contractor for the Atlantic Missile Range, is recommending that the northern coast of the Cape be extended 3 mi. out into the Atlantic.

NASA and Defense Department have also established a three-man Executive Committee for Joint Lunar Study, composed of one NASA representative, one USAF officer and one USAF officer who is assigned to NASA, and a two-man (one NASA, one USAF) Joint Lunar Study Program Office in the Air Force Missile Test Center headquarters building at Patrick AFB, just south of the Cape. Operating under what amounts to a priority, the committee and program office for the past month have been convening joint, informal working groups of specialists from all NASA and Defense organizations for periods of several days to weeks to study and define various support requirements.

All reports from the groups are compiled by the program office and forwarded through the committee to NASA headquarters in Washington, D. C., with copies provided to DOD.

Acquisition of the northern part of Merritt Island will preclude further residential development of the land, now relatively unpopulated and considerably less expensive than nearby Cocoa Beach. There are about 100 homes on the island, with the bulk of the land given over to orange groves.

The strip of beach north of the Cape, which the government is now considering and will probably buy, comprises Sunrise, Titusville and JayCee beaches and includes about the same number of homes as Merritt Island, with one subdivision of 50 new houses.

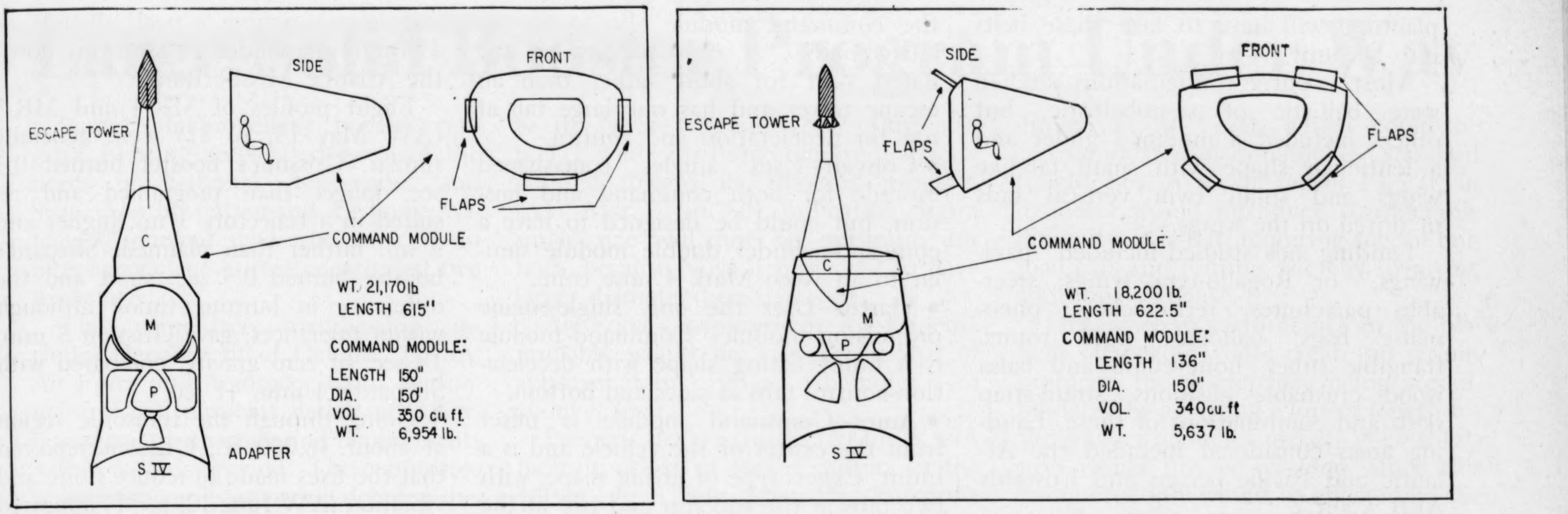
Addition of this land to the Cape reservation will considerably alleviate the safety problem for the Atlantic Missile Range. Biggest potential difficulty associated with the launch of a large booster such as Saturn is not the blast effects of a possible failure, but the very high noise levels which can damage both humans and homes.

NASA's Marshall Space Flight Center, Huntsville, Ala., has determined that 135 db. is about the maximum level to which humans should be exposed. For a greater safety margin, NASA has decided to use 120-125 db. as a working figure. Based on static test firings of the S-I first stage engines, NASA expects Saturn to generate about 160 db. at liftoff in the launch area, 135 db. 0.5 mi. distant and 105 db. around a circle with a 6-mi. radius.

Other uses will be found for the land, besides sonic safety—Merritt Island will be the site of range instrumentation stations, perhaps a liquid hydrogen plant and other support buildings. The beach strip will undoubtedly be the site of either additional Saturn launch complexes or Saturn control centers.

Various land-fill schemes for the northern half of the triangular-shaped Cape have been discussed for years. Presently, however, two plans appear to be receiving more than passing interest. The first proposal would fill an area 0.5 mi. wide and 3 or 4 mi. long on the back, or Banana River, side of the Cape, starting a few thousand feet below the present northern boundary and extending to a point inland from Titusville Beach.

The other plan calls for filling a strip 3 mi. wide out into the Atlantic on the northern slope of the Cape's coastline. The latter seems more probable, in view of the ambitious production schedule set for Saturn. A heavy launch schedule would require a large number of launch facilities, spread over a wide area so as to minimize the damage by the explosion of any one vehicle.


SIDE
FRONT
ESCAPE TOWER
FLAPS
COMMAND MODULE
C
M
P
S IV
ADAPTER
WT. 21,170 lb
LENGTH 615''
COMMAND MODULE:
LENGTH 150''
DIA. 150''
VOL. 350 cu. ft.
WT. 6,954 lb.
SIDE
FRONT
ESCAPE TOWER
FLAPS
FLAPS
COMMAND MODULE
C
M
P
S IV
WT. 18,200 lb.
LENGTH 622.5''
COMMAND MODULE:
LENGTH 136''
DIA. 150''
VOL. 340 cu. ft
WT. 5,637 lb.

**AVIATION WEEK ARTIST'S** concept of preliminary designs for NASA's Apollo spacecraft shows Martin Co. vehicle (left) and Ames Research Center vehicle (right). Both use tabs or flaps on re-entry capsule for deceleration and aerodynamic control.

# Apollo Designs Use Nose Cone Concepts

Washington—All four preliminary design concepts for the three-man Apollo spacecraft lean heavily on known ballistic missile nose cone technology, but two introduce enough aerodynamic control so that the re-entry capsule could return to land instead of making a water landing as the Mercury capsule does.

Designs produced by General Electric, Convair and Martin under National Aeronautics and Space Administration contracts, and a fourth produced by NASA's Ames Research Center, were presented to 1,040 industry representatives and about 100 representatives of other government agencies at a NASA briefing here July 18-20.

NASA plans to issue requests for proposals for development of the Apollo within two weeks after Congress appropriates the $160 million requested for Fiscal 1962. Specifications which allow considerably more latitude than those issued for Mercury in 1958 probably will be ready by late September, and NASA hopes to award a contract by Dec. 31.

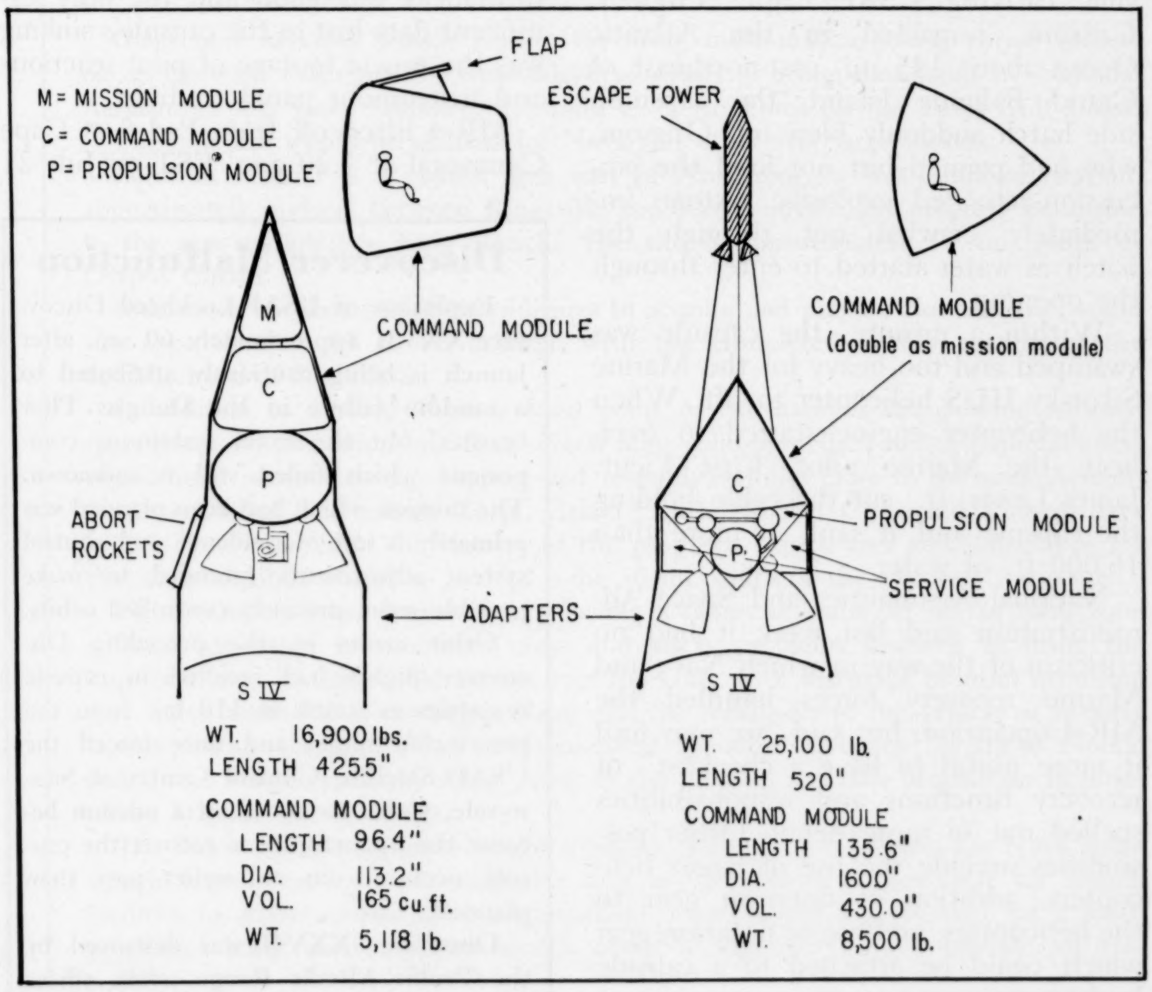
The three-day briefing dealt chiefly with the earth-orbit mission planned for Apollo A and the circumlunar mission planned for Apollo B. Observers said NASA and its three study contractors apparently have given relatively little study to the lunar landing mission planned for Apollo C—a requirement which was added to the program last May by President Kennedy.

All four preliminary designs exceeded the desired 15,000-lb. weight by margins ranging from 1,900 lb. to 5,100 lb. None included the extra propulsion module that will be needed for the return trip from the moon in Apollo C.

NASA put heavy emphasis on crew safety—apparently the chief lesson it has derived from the Mercury program. It hopes to provide a "shirtsleeve" environment for the crew, which will consist of a pilot-commander, a navigator-pilot and an engineer-scientist. Capability for crew control of vehicle at all times will be provided if possible.

Liquid hydrogen and liquid oxygen apparently will be the propellants for the main propulsion system, which will be used for entry and exit from lunar orbit, for midcourse corrections and for super-orbital abort. This combination is superior to storables in weight and is favored over the other potential propellants considered—high energy solids, current or future storables and liquid hydrogen with a fluorine oxidizer. Ablatively cooled thrust chambers also were favored by NASA.

Consensus of the studies is that ablating-radiator surfaces will suffice for heat protection and that shielding must be carried to offset the significant probability that radiation from solar flares will be encountered. Van Allen belt radiation is not considered the primary mission hazard, but trajectory


M = MISSION MODULE
C = COMMAND MODULE
P = PROPULSION MODULE
FLAP
COMMAND MODULE
M
C
P
ABORT ROCKETS
ADAPTERS
S IV
WT. 16,900 lbs.
LENGTH 425.5''
COMMAND MODULE
LENGTH 96.4''
DIA. 113.2''
VOL. 165 cu. ft.
WT. 5,118 lb.
ESCAPE TOWER
COMMAND MODULE
(double as mission module)
C
P
PROPULSION MODULE
SERVICE MODULE
S IV
WT. 25,100 lb.
LENGTH 520''
COMMAND MODULE
LENGTH 135.6''
DIA. 1600''
VOL. 430.0''
WT. 8,500 lb.

**GENERAL ELECTRIC'S** Apollo design (left) uses retro-rockets around flared skirt for aborting flight in launch phase, rather than escape towers featured in other designs. Convair concept (right) has a common command-mission module.

planning will have to take these belts into account.

Most re-entry configurations studied were ballistic or semi-ballistic, but others included a modified glider and a lenticular shape with small tab-like wings and small twin vertical tails mounted on the wings.

Landing aids studied included "parawings," or Rogallo-type wings; steerable parachutes, retro-rockets, pneumatic bags, balloons, rigid rotors, frangible tubes, honeycomb and balsa wood crushable cushions, strain-strap skids and combinations of these. Landing areas considered included the Atlantic and Pacific oceans and Edwards AFB, Calif.

Principal features of the four design concepts (see drawings, p. 29) are:

- **General Electric**—Design has three separate modules—command, mission and propulsion. As in all four designs, the command module also is the reentry body. It uses rockets on the flared skirt for abort rather than an escape tower and has one large tab at top for deceleration and control.
- **Convair**—Uses single, cone-shaped module for both command and mission, but could be designed to have a cone-and-cylinder double module similar to an Avco Mark 4 nose cone.
- **Martin**—Uses the only single-engine propulsion module. Command module is a blunt lifting shape with deceleration-control tabs at sides and bottom.
- **Ames**—Command module is offset from the center of the vehicle and is a blunt, Eggers-type of lifting shape, with two tabs at the top rear and two at the rear of the underside. Mission module has 1,300-cu.-ft. volume, compared with 126 for GE, 380 for Martin and 430 for the combined command and mission module in the Convair design.

# Loss of MR-4 Capsule Triggers Downrange Recovery Plan Review

**Cape Canaveral**—Loss of the Mercury-Redstone 4 capsule has resulted in a searching review of downrange recovery procedures that is expected to produce changes in plans—and possibly equipment—to assure safe retrieval of future pilots and capsules.

Several minutes after the MR-4 capsule, carrying USAF Capt. Virgil I. Grissom, impacted in the Atlantic Ocean about 145 mi. east-northeast of Grand Bahama Island, the capsule's side hatch suddenly blew off. Grissom, who had primed but not fired the percussion-activated explosive system, immediately crawled out through the hatch as water started to enter through the opening.

Within a minute, the capsule was swamped and too heavy for the Marine Sikorsky HUS helicopter to lift. When the helicopter engine started to overheat, the Marine pilot, First Lieut. James Lewis, Jr., cut the cable holding the capsule and it sank in more than 16,000 ft. of water.

National Aeronautics and Space Administration said last week it had no criticism of the way in which Navy and Marine recovery forces handled the MR-4 operation, but said "we may find it more useful to have a checklist" of recovery functions and responsibilities spelled out in more detail. Other possibilities include the use of larger helicopters, addition of flotation gear to the helicopters, and use of flotation gear which could be attached to a capsule by frogmen.

Reason for the hatch's premature explosion—which should have been activated by a plunger off the pilot's right shoulder inside the cabin—is still undetermined, but NASA speculation is that the hard impact of the landing may have primed the system and, after Grissom removed the safety pin, the slapping of waves against the capsule's side may have triggered the charge.

Telemetry of booster and capsule performances was good and the only significant data lost in the capsule's sinking was the movie footage of pilot reactions and instrument panel readings.

MR-4 lifted off from Pad 5 at Cape Canaveral at 7:20 a.m. EST on July 21 and, after reaching a peak altitude of 118 stat. mi., landed 305 stat. mi. down the Atlantic Missile Range.

Flight profiles of MR-4 and MR-3 (AW May 15, p. 31) were generally similar. Grissom's booster burned 0.3 sec. longer than programed and resulted in a trajectory 3 mi. higher and 9 mi. farther than planned. Shepard's booster burned 0.5 sec. short and the difference in burning times, although within tolerances, gave Grissom 5 min. 18 sec. of zero gravity, compared with Shepard's 4 min. 41 sec.

Going through the transonic region at about 36,000 ft., Grissom reported that the fixes made to reduce noise and vibration (AW June 12, p. 31) appeared satisfactory. At time of booster burnout, the MR-4 capsule—nicknamed Liberty Bell 7—was traveling at 5,280 mph. inertial speed, which includes the rotational speed of the earth, compared with the MR-3 speed of 5,160 mph.

Attitude of 34 deg. was used both as MR-4's cruise attitude and as the angle at which retrorockets are fired, as specified in orbiting Mercury-Atlas flight plans. Autopilot pitched the capsule to this attitude immediately after booster separation and spacecraft turnaround. Shepard cruised at 14.5 deg. The greater cruise angle used for Grissom's flight provided a better antenna pattern for communications and a better look-angle for pilot observations.

High-frequency radio communications were tried just prior to re-entry, but with little success. Mercury Operations Director Walter C. Williams, along with Astronaut John Glenn, later said there is probably a skip-distance problem with HF communications. UHF transmissions were reported to have been "very clear" throughout the flight.

G-forces during the boost phase were about the same—six—for both Grissom and Shepard. At re-entry, Grissom was subjected to a peak of 10.2 g's, while Shepard took 11.

Grissom was assigned fewer tasks to perform during the flight than his predecessor and was expected to make more observations through the new trapezoidal window, which is 19 in. by 11 in. by 7.5 in. The pilot reported a good many sightings and said he was "fascinated" by the view.

Launch of MR-4 was originally scheduled for July 18, but the forecast of clouds which would have prevented optical coverage of the vehicle during boost caused a one-day postponement. On Wednesday, July 19, rain and clouds again prevented the flight and MR-4 was rescheduled to July 21. Following the second postponement, the booster's liquid oxygen was dumped and the tankage purged and dried. The alcohol-water fuel remained aboard the Redstone for five days.

## Discoverer Malfunction

**Explosion of USAF-Lockheed Discoverer XXVII approximately 60 sec. after launch is being cautiously attributed to a random failure in the Douglas Thor booster, but the exact system or component which failed still is unknown. The mission which had been planned was primarily a test of guidance and control system adjustments intended to make possible more precisely controlled orbits.**

**Orbit errors in the preceding Discoverer flights had resulted in capsule re-entries as much as 110 mi. from the preselected target and once forced the USAF Satellite Control Center at Sunnyvale, Calif. to cut short a mission because the opportunity to recover the capsule occurred on an earlier pass than planned.**

**Discoverer XXVII was destroyed by the Pacific Missile Range safety officer 60 sec. after launch but the Air Force has made no official statement on the reason for destruction.**

# Large Solid Booster Program Under Way

Large solid-propellant booster program is being accelerated to meet the needs of National Aeronautics and Space Administration and Air Force Systems Command space programs by an inter-agency committee constituted two weeks ago.

The committee membership includes Department of Defense, NASA, Air Force and Aerospace Corp. personnel and will pinpoint details of policy, management structure and requirements within a 90-day period. The committee is simultaneously preparing detailed specifications and issuing requests for proposals.

The program generally will be tailored to meet NASA requirements, but Air Force will manage the program, with NASA coordination, through the development phase and preliminary flight readiness testing.

Requests for proposals for the large solid-propellant boosters may be issued late in August or early September, depending on coordination of government-agency ideas concerning stage diameter and weights, on which there appears to be a discrepancy of opinion. The segmented-rocket configuration almost is certain to be favored.

Proposal submissions likely will be required within two weeks after requests are issued, but this should pose no hardship for the solid-rocket industry bidders, since the general requirements of the program have been anticipated for some time and, except for some refined inputs, industry is ready for the competition.

### Letter Contracts

Letter contracts may be awarded as early as two weeks after proposal submissions. This means that if a tight schedule is maintained, contractor selection may be as early as Oct. 1.

Management of the program will be put on a streamlined basis. Air Force effort will be directed by Col. Langdon Ayres, Ballistic Systems Division, temporarily working with Space Systems Division for this specific task.

Delays in review of program management progress will be minimized through the medium of detailed reports supplied at regular, frequent intervals by Lt. Gen. Howell M. Estes, Air Force Systems Command's deputy commander for aerospace systems, to Gen. Bernard A. Schriever, commander, Air Force Systems Command. This procedure will permit major management decisions by Col. Ayres, after review by Gen. Estes, to be presented directly to the Secretary of the Air Force.

NASA's requirements for the large solid propellant booster will be directed to its Nova program (AW June 19, p. 32), while Air Force requirements are pointed toward its Phoenix program (AW Mar. 27, p. 50), indicating that a single size will not be optimum for both, because Nova is projected to have larger diameter boost rockets.

Air Force's requirement for Phoenix probably would be a rocket motor of approximately 100-in. diameter, or about 8.33 ft.

Previous studies conducted for NASA indicate utility of rocket motors in the 140-in. to 170-in. diameter category, but probability is that even a 160-in. diameter motor (13.3 ft.), which may be the specific unit under consideration, might be too large for rail transportation.

The NASA motor will be the one to receive priority development, unless Air Force can promote funds for simultaneous development of its 100-in.-dia. rocket.

### Motor Diameter

Industry observers in the solid propellant field feel that 12.5 ft. diameter is a reasonably convenient size to handle, because allowing one-half foot for the enclosing handling gear would bring the dimension to 13 ft. which could be accommodated reasonably by standard freight cars. A rocket motor 13.5 ft. in diameter would introduce considerable difficulty, it is felt, requiring special railroad cars and routing, thereby incurring additional expense.

Difference in performance in the two sizes of rockets would create no serious problem, the discrepancy being accommodated by adopting a longer length for the smaller diameter rocket. Web thickness would not be affected, since this parameter only would be affected by the slump (flow) characteristics of the specific propellant.

### Contractor Selection

For development of the larger NASA motor, probability is that two contractors would be selected for parallel development, supplemented by simultaneous development of fluid injection thrust vector control devices.

At any time in the program, if Air Force received permission to proceed with its 100-in.-diameter motor, a new, third contractor would be selected.

Full-diameter, single-segment units will be involved in initial tests by each contractor. First test in the single-

## Gulf Site Considered for Nova

**Giant new national launch facility for firing multi-million-pound thrust rockets on an eastward trajectory for equatorial-type orbits is being considered by National Aeronautics and Space Administration and U. S. Air Force for the Texas Gulf Coast.**

**The new site would be utilized for Nova and other very large rockets.**

**Location favored is a coastal area east of Armstrong, a small railroad station, approximately midway between Kingsville and Raymondville, on property belonging to the near-million-acre King Ranch. The site is approximately 50 mi. south of Corpus Christi.**

**Indications are that initial expenditures to acquire and prepare the new site would run approximately $5 to $6 million, with the completed facility costing in the neighborhood of $1 billion.**

**In addition to making Texas a focal point in the nation's fast-growing national space program, indications are that several large solid-propellant motor manufacturers would build manufacturing, support and research facilities close to the area. Aerojet-General, United Technology Corp., Grand Central Rocket Corp. and Thiokol have been looking at sites in the vicinity of the proposed launch area and indications are that such facilities would be located some 50 mi. south of the site near the coast.**

**Plan for the site envisages an area having a radius of some 30 mi. of clear zone without habitation to minimize noise and safety problems involved in firing the huge boosters. Firings would be out over the Gulf, with first-stage burnout occurring over water west of the Mississippi River and the remainder of the vehicle or re-entry bodies passing through a 90-mi.-wide so-called "window" between the tip of Florida and Cuba. Programs could utilize some of the tracking and data acquisition facilities of the Atlantic Missile Range.**

**The NASA Marshall Space Flight Center's industry competition for Nova space vehicle launch facility study contracts may be awarded in August, one for launch facilities to accommodate a liquid-propellant boost cluster and another for a solid-propellant boost cluster. Each launch complex apparently would provide for two pads.**

**The Texas launch site is situated to provide convenient water transportation of large-vehicle components to the area. Padre Island, extending from Corpus Christi southward over 100 mi. offshore, forms a protected inland waterway.**

## Saturn Program Acceleration Planned

**Washington—Production contract for the Saturn S-I booster stage will specify use of a government-owned plant in Louisiana and will be awarded by the National Aeronautics and Space Administration 35 days after a bidders' conference to be held Aug. 3-4 at the plant.**

**Accelerating the Saturn system as an essential part of the manned lunar landing program, NASA will call for bids 30 days after the conference at Michoud, La.—about 10 mi. northeast of New Orleans—and will issue a letter of intent to the winner five days after reception of bids. Contract probably will also include the construction of two static test facilities about 20 mi. south of New Orleans on the Mississippi River delta.**

**General Dynamics/Astronautics and Douglas are leading contenders for the contract, and Chrysler—on the strength of its Mercury-Redstone booster performance—also is a prospect.**

**Initial output of the 2-million-sq.-ft. plant, a tank factory during World War II, will be one booster a month, building to 50 units a year by the 1964 period.**

**Industry sources report that the plant's solid foundation is more than adequate for the weight of S-I, but that the 40-ft-high roof will probably have to be raised another 20-30 ft. to allow for handling of the vehicle during fabrication.**

segment series probably will be concluded no later than the end of next May.

Concurrently with these runs, firings will be conducted with smaller motors to investigate thrust vector control.

### Vehicle Configuration

The complete full-size configuration may include seven segments, more likely eight, since more than one million pounds of propellant per rocket will be required. As many as 10 of the full-size motors may be projected to be built by each contractor. First of the 10 full-scale rockets may be fired as early as September, 1962, with six more firings concluded by the end of January, 1963—a difficult schedule to maintain. Following this, Air Force/NASA probably will decide on one design, which will be evaluated in design verification tests by each contractor using the last three rockets of the series of 10.

Both contractors probably would participate in the follow-up production program for the single design selected.

NASA probably will conduct its own test with a cluster of eight of the rockets in mid-1963, with each of the manufacturers supplying four of the rocket motors. Following this, NASA will conduct destruct hazard tests, with as many as three or four of the rocket motors.

### Preliminary Testing

Preliminary flight readiness testing may be scheduled for the fall of 1963, with Air Force monitoring the program. Eight rockets likely will be involved—four supplied by each contractor—and firings may be spaced approximately one month apart, so that preliminary flight readiness testing probably will not be completed until June, 1964.

Air Force responsibility probably will end after completion of preliminary flight readiness testing. NASA is expected to assume responsibility for deliveries of the rocket motors from the manufacturers and for any additional firings.

Immediately after the preliminary flight readiness testing, probably in June, 1964, the vehicles will undergo tests to ensure that projected flight conditions will not preclude the possibility of an abort maneuver.

## House Votes Funds For Military Construction

**Washington**—House last week voted $812 million for military construction —40% of it earmarked for missile facilities.

The services already have over $600 million in unobligated construction funds on hand.

The House approved $282 million for the Minuteman solid propellant intercontinental ballistic missile program, including $270 million for support of operational squadrons and $1.5 million for modifications to launch facilities at Cape Canaveral and Vandenberg AFB.

The $812 million is divided: Air Force, $480 million; Navy, $181 million; Army, $151 million.

Air Force's request for $12 million for solid-propellant booster test facilities to support the launch program was omitted from the appropriation measure passed by the House and is now before the Senate appropriations committee. House appropriations committee postponed action on the project until Air Force presents it with firm plans. USAF has estimated the ultimate cost in the neighborhood of $100 million. Under Secretary of Air Force Joseph Charyk told the House committee in mid-June that the project would involve static test facilities at Edwards AFB and launch facilities at Cape Canaveral.

Facilities funded were:

- **Aerospace systems environmental** test chamber, $17.5 million. This facility, which will be located at the Arnold Engineering Development Center, will be for the testing of complete space vehicles under all space conditions having a significant effect on performance, such as temperature, thermal-radiation, vacuum, and vibration. Radio Corp. of America has done the design work.

In approving the project, House appropriations committee observed:

"It is felt that the testing of whole vehicles will provide test data not presently obtainable by component testing and which can only otherwise be obtained by the very expensive process of placing vehicles in orbit and obtaining data by telemetering methods."

The facility will be constructed and operated by Air Force, but it will be available for use by National Aeronautics and Space Administration and the other military services. Deputy Defense Secretary Roswell Gilpatric reported that projects planned for testing in the chamber includes the Defense Department Advent, Transit, Midas, Samos, and Saint, and the NASA programs for the Nimbus weather satellite, orbiting astronomical observatory, orbiting geophysical observatory and orbiting solar observatory. Tests will be scheduled on a basis of "national priority," he said.

- **Dyna-Soar test facilities,** $7.5 million. This will mainly be for modification of pads at Cape Canaveral to accommodate the launch vehicle.
- **Naval Radio Research Station,** Sugar Grove, W. Va., $36.6 million. This is to continue construction of the communications center, now approximately half completed. The House set a $135 million ceiling on the total cost.
- **Nike Zeus research** and development facilities at the Pacific Missile Range, $1.5 million.
- **Midas,** $3.5 million. This will provide tracking and control facilities for advanced development and testing of the ICBM warning satellite system.

## 425L, 480L Systems Contractors Chosen

**Washington**—Air Force has chosen the Burroughs Corp. as system hardware contractor for development and production of the 425L command and control system for the North American Air Defense Command combat operations center.

USAF also has selected Space-General Corp., a new subsidiary of Aerojet-General, as principal contractor for the 480L Air Force Communications System.

Mitre Corp. and System Development Corp. are to be associate contractors for the system computer programing task for the 425L system, which will be installed in the Norad control center near Colorado Springs, Colo.

**Breguet 941 STOL Prototype Flight-Tested**

**Breguet 941-01 STOL transport has logged 12 hr. of flight and company officials claim that the French-built aircraft has confirmed takeoff performance figures (770 ft. on grass at 20-ton gross weight) and cruising speed of 215 kt. (AW June 12, p. 103). The four-engine 941 is powered by Turbomeca Turmo IIID free turbines delivering 1,250 shp. each. Plane is designed for civil and military applications.**

# AEC, Defense Awaiting Nuclear Test Approval

**Washington**—Atomic Energy Commission and Defense Department are awaiting approval from the White House to proceed with a series of 13 nuclear underground explosions to develop the detection devices required for an effective nuclear weapons test ban agreement.

Testimony on the program was presented last week to the Joint Congressional Atomic Energy Committee at hearings which highlighted the present meager capability to detect decoupled underground explosions and shielded space explosions.

Dr. Richard Latter, chairman of Defense Department's ad hoc group for Project Vela studying detection of nuclear detonations, told the committee that there is no solution now on the horizon for the detection of these two types of explosions. To find a solution, he said, will require "extensive research," including underground detonations and an "expensive" satellite program.

Dr. Carl Romney, assistant director of the Air Force Technical Applications Center, which will handle the instrumentation for the measurement and analysis of signals from the firings, said that the information which will result from the explosion program "will fully justify the effort required." He expressed confidence that "we have the know-how" to proceed with the difficult problems of signal analysis.

## Minuteman Test Flight

**Cape Canaveral—Air Force successfully flew the third solid propellant Minuteman 5,000 mi. down the Atlantic Missile Range July 27, despite loss of telemetry. Second Minuteman, launched May 19, exploded after second stage separation and ignition. Malfunction was traced to a loose soldered connection between the thrust vector control system and a nozzle activator.**

# News Digest

**White House** approved a Civil Aeronautics Board decision last week to review the current impact of airline service and capacity which would result from additional transpacific routes recommended for Pan American World Airways and Northwest Airlines but vetoed last January by former President Eisenhower because of its competitive effect on Japan Air Lines. CAB also will determine in the reopened transpacific case whether existing controls would prevent the carriers from operating too much capacity on the proposed new routes.

**USAF-Martin Titan-M** flew 5,000 mi. down the Atlantic Missile Range July 25 in the first full range closed-loop flight of the Titan II all-inertial guidance system developed by AC Spark Plug and International Business Machines. On July 20, a Titan-J also flew 5,000 mi. downrange, with a special pod on the second stage carrying a number of decoys—presumably to test discrimination ability of Nike Zeus radar at Ascension Island.

**Douglas Aircraft Co.,** has reported a profit of $1,509,000 for the second quarter of Fiscal 1961. Total net profit for the first six months was $3,225,000 or 84 cents per share.

**American Airlines'** net earnings for the second quarter of 1961 totaled $4,506,000, up from $3,885,000 in second quarter 1960. Total net for first six months of 1961 was $2,540,000, down from $3,431,000 for the first half of 1960.

**West Germany** is placing an order worth about $120 million for the Army-Martin Pershing tactical missile system.

**Sikorsky Aircraft** has signed a technical cooperation contract with Sud Aviation under which Sikorsky will provide design, test and construction aid in Sud's Super Frelon 3210 helicopter program, primarily on rotor systems.

**General Dynamics/Astronautics'** roving team will train Atlas-D launch crews in revised operational procedures and in minor changes in automatic checkout and launch control equipment under a program called Golden Ram-Follow On. Crews to be trained originally were assigned to operational sites before Project Golden Ram (AW Mar. 13, p. 125) was initiated.

# AIR TRANSPORT

# Soviets Plan Special Supersonic Transport

## Aeroflot chief says fresh design will be developed, contradicting speculation Bounder would be modified.

By David H. Hoffman

**Washington**—Soviet Union's entry in the international race to fly the first civil supersonic transport probably will be an aircraft of fresh design and not a military bomber converted to carry passengers.

Col. Gen. Yevgeni F. Loginov, chief of Soviet civil air operations and head of Aeroflot, told Aviation Week last week that the problems of sustained supersonic flight demand an original design concept. Gen. Loginov thus contradicted Western speculation that the Russians would adapt Bounder—a very large, high delta-wing, supersonic bomber with intercontinental range (AW July 17, p. 31)—as a supersonic transport prototype.

Publicly displayed for the first time at the Tushino air show this month, Bounder has a wing-fuselage-powerplant combination that some experts believe adequate for prolonged cruise at speeds between Mach 2 and 3. Photographs of the bomber touched off U.S. industry speculation that the Russians would introduce a supersonic civil transport based on Bounder not later than 1965. Ample Soviet precedent for such an approach exists, since both the Tu-104 twin-jet and Tu-114 four-turboprop transports now in Aeroflot service were evolved from Red Air Force bombers.

But Gen. Loginov, here as head of the Soviet delegation negotiating a bilateral air transport agreement with the U.S., said last week that "it was not correct" to use this approach in designing a supersonic aircraft strictly for carrying passengers.

Speaking through an interpreter, he said that it would be "more economic and useful" to design a civil supersonic transport as such from the start.

### Parallels U.S. Course

Gen. Loginov's observations indicate that the Soviet Union is following a course parallel to the one charted by the Federal Aviation Agency for U.S. supersonic transport research and development. In recent appearances before congressional committees, FAA Administrator N. E. Halaby has said that sharp cutbacks in the B-70 bomber program would have little or no effect on when a U.S. supersonic transport first earns its type certificate. He said the supersonic transport program should proceed independently.

Commenting on whether the Soviet Union under its current Seven Year Plan has set a supersonic transport first flight target date, Gen. Loginov said "not specifically." But he added quickly that "we will not lag behind," and when reminded of his government's claim that Russia would be the first nation to inaugurate service with such a transport, he said "that may well be the case."

Gen. Loginov, whose specific title is Chief of the Main Administration of the Civil Air Fleet attached to the Council of Ministers of the USSR, is the top executive officer of Aeroflot. Despite his high position in the Soviet hierarchy, he carefully skirted all questions on Russian aircraft nuclear propulsion progress and target dates. He also declined comment on the main points at issue in the U.S.-USSR bilateral talks now under way in an atmosphere made tense by President Kennedy's firm stand on Berlin.

### Soviet Refusal

The Soviet Union has firmly refused so far to join either the International Civil Aviation Organization or the International Air Transport Assn. However, Gen. Loginov reported that Soviet civil aviation authorities have made it a practice to attend important ICAO and IATA conferences, that these authorities are studying the material disseminated by the two organizations and that "there now exists a good business-like relationship" between ICAO and IATA and the Soviet Union.

Next two aircraft Aeroflot intends to introduce in scheduled service are the Antonov An-24 twin-turboprop and Tupolev Tu-124 twin-turbofan transports. At a May press conference at Moscow's Vnukovo Airport (AW May 22, p. 41), Gen. Loginov predicted that the An-24 would be placed on domestic feeder routes this year and that the Tu-124 would follow "in the very near future."

But last week, he said that neither transport will carry passengers until, he hopes, sometime in 1962. Both aircraft, meanwhile, are hauling freight within the Soviet Union in line with Aeroflot's policy of proving reliability and shaking down new transport designs in this manner.

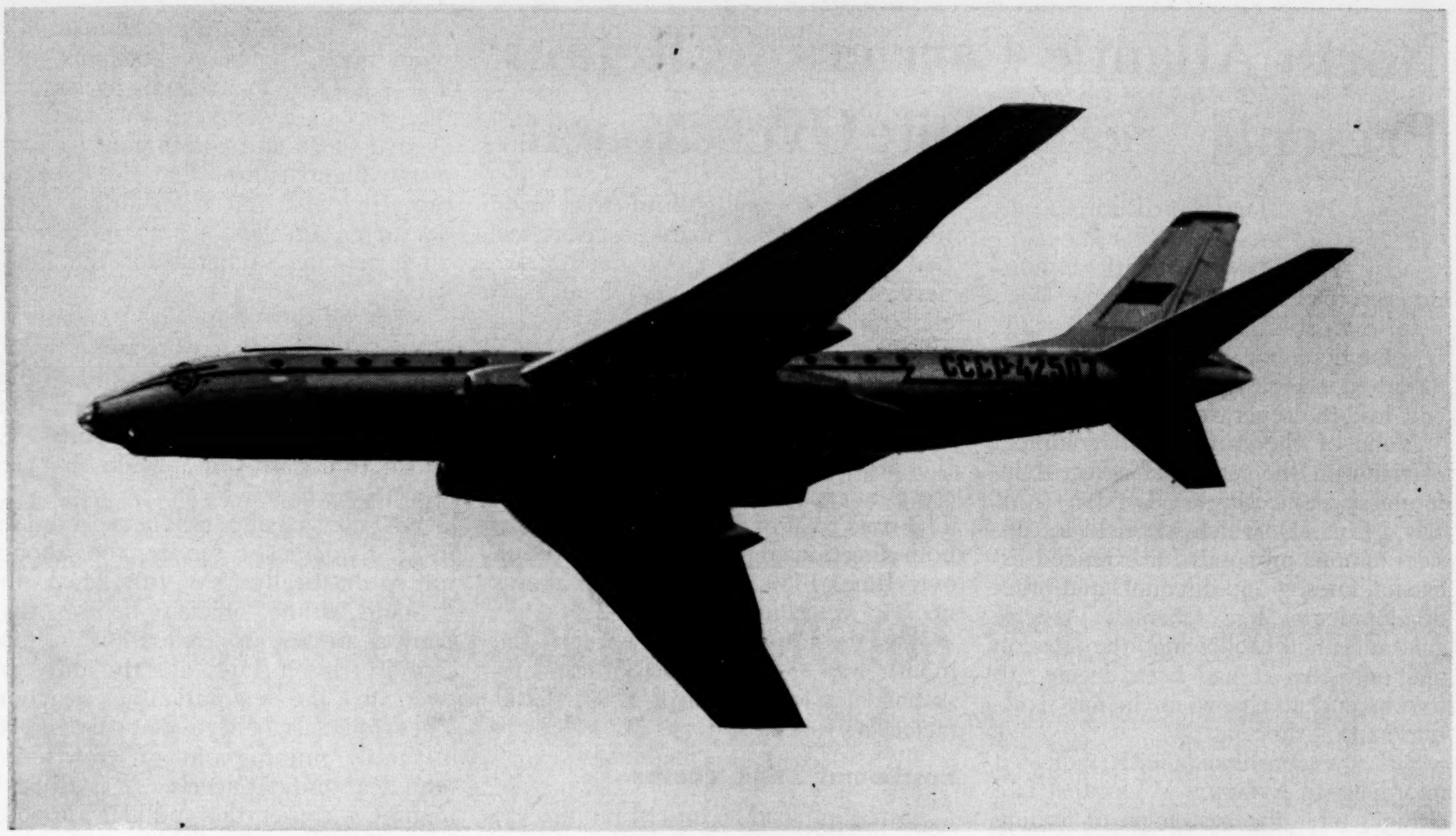
Despite the relatively minor slippage in starting An-24 and Tu-124 service, Gen. Loginov clearly indicated that Aeroflot is outstripping the goals set for it by the Seven Year Plan that began in January, 1959. In 1959, for example, Aeroflot set its sights on boarding 45 million passengers in 1965 (AW July 6, 1959, p. 34). Gen. Loginov said that the goal now is far too low. Although total 1960 boardings still have not been tabulated—such statistics are kept at the republic or province level in Russia—the Soviet official said that Aeroflot carried "tens of millions of passengers" last year. Its goal, by contrast, was 21 million passengers.

### Growth Factors

At the root of Aeroflot's explosive growth are at least four major factors: the Soviet government's policy decision to make the state airline monopoly the primary mode of national passenger transportation; the low fares charged by Aeroflot and the scrapping, about two years ago, of different classes of service on domestic routes; the airline's rapid transition to turbine-powered equipment, and the vast expansion of feeder routes in outlying areas of the country.

In 1965, Aeroflot predicts that turbojets and turboprops will carry 95% of its total traffic. Last year, according to Gen. Loginov, the volume was better than 50% and this year it has been averaging better than 60%. Regardless of this emphasis on the shift to jets, he said that more than half of Aeroflot boardings now are local service passengers traveling routes often served by piston-powered aircraft. Gen. Loginov also disclosed that:

- **Aeroflot aircraft** now are operating the extreme Arctic and in Antarctica, presumably to support Soviet scientific expeditions.
- **Tu-114 service** now is available on a daily basis between Moscow and Khabarovsk in eastern Siberia and as yet not a single major delay has been experienced.
- **Peak daily utilization** in the Aeroflot fleet is about 12 hr., but this is achieved on transports assigned to fly long-range routes.



**Soviet Turbofan-Powered Tu-124 Tested on Aeroflot Routes**

Soviet Tu-124 twin-jet transport, smaller version of the Tu-104, carries up to 60 passengers in three separate compartments for short- to medium-range stages. Soviet sources state maximum cruise is 1,000 km./hr. (621 mph.) and normal cruise is 800 km./hr. (495 mph.) Airplane, now in limited service with Aeroflot, is first Soviet turbofan transport. The engines, designed by Soloviev, are housed in wing root nacelles. Area rule bulges on the wing probably carry fuel. Note radome bulge under nose.

# Engineers Urge Changes in DC-8 Hydraulic Systems, Procedures

**Washington**—Flight Engineers International Assn. last week urged the adoption of new instrumentation and operating procedures designed to prevent inflight malfunction of the Douglas DC-8 hydraulic control systems.

The union suggested to both the Federal Aviation Agency and the Civil Aeronautics Board that the danger of emergency landings with damaged hydraulic systems could be reduced by expanding the present emergency operations procedures to permit inflight repairs, modifying the hydraulic system to prevent an unnecessary loss of fluid, replacing the present hydraulic fluid quantity indicators with a more accurate type of instrument and placing the hydraulic system controls on all DC-8s at the flight engineer's panel.

Citing the July 12 emergency landing of an Eastern Air Lines DC-8 at Miami, the letter pointed out the emergency was caused by failure of a hydraulic hose on the number two engine and contended that the crew could have restored full hydraulic pressure inflight but was prevented from doing so under the airline's current operational procedures.

FAA hydraulic procedures, outlined in a July 13 letter to all DC-8 operators, were termed "far superior" to those of the past, but FEIA urged that they be further expanded and standardized for inclusion in all company operational manuals. The more detailed procedures should spell out repairs approved for normal, abnormal and emergency situations, the union said.

Present hydraulic fluid quantity indicators on the DC-8 contain only normal and low area readings, fail to give an adequate picture of the amount of remaining fluid and do not give the operator enough accurate information to judge the severity of a malfunction or the area of a leak. The union called for an FAA airworthiness directive which would make mandatory the installation of a new type of indicator including readings for normal, auxiliary and emergency fluid supply.

The union also suggested the addition of electrically operated hydraulic pump suction valves on each engine to isolate the flow of fluid to the pumps and prevent a further loss of the supply. Under the present system, FEIA said, fluid can still flow from the supply reservoir to the break in the line until the level drops below the normal supply.

To avert the dangers of veering from the runway during an emergency landing because of uneven air brake pressures, FEIA suggested that anti-skid controls be turned off under emergency conditions. Braking action used during emergency landing is dependent on a limited amount of accumulated hydraulic pressure, with only five or six applications available to the pilot. Retaining the anti-skid control under these conditions could deplete the remaining hydraulic supply much faster if excessive brake pressure is applied, FEIA said.

# North Central Buying Routes From Frontier

**Washington**—North Central Airlines has requested Civil Aeronautics Board approval of the purchase of four route segments involving 16 cities and 1,376 route mi. from Frontier Airlines.

North Central says the sale, if approved, will make its route system the largest of the local service airlines. The four segments are in Montana, North Dakota and South Dakota.

North Central has told CAB that the route transfer would result in a $453,000 annual reduction in subsidy. The airline also estimates its annual profit would increase by $200,000.

# North Atlantic Carriers to Retain Present Fares Despite Overcapacity

By Glenn Garrison

**New York**—North Atlantic airlines' decision to retain the status quo on fares despite a critical overcapacity situation is being described by some officials as a "head in the sand" attitude that will only lead to deeper trouble.

None of the carriers will comment officially on the results of a recent informal fare meeting in London (AW July 24, p. 41), which was held to consider various proposals for extended excursion fares, group discounts and other developmental fare schemes. A terse announcement following the session said only that it had been decided to recommend no change in the fare structure at this time.

But several airline officials indicated informally to AVIATION WEEK that fare changes offer the best hope of finding new markets to offset the serious spread between available seats and available passengers. They felt that airlines which consider the present situation a temporary maladjustment that will automatically right itself are deceiving only themselves.

At the London meeting, there reportedly was considerable opinion that action on fares was needed. What stalled any recommendation for new fares was failure to agree on specific proposals. One area of controversy was group fare reductions for about 40 people versus a 23-day, year-round excursion fare for individuals. Since the status quo now will prevail, the 17-day excursion off-season fare inaugurated last fall on the Atlantic will go into effect again next October. But many observers feel that this falls far short of meeting the need. Some feel that it drains off first-class traffic. In any case, this fare has no effect during the on-season period.

Loads on the route picked up somewhat last month over May. The May traffic actually had declined 1% from the previous May despite a 41% increase in capacity (AW June 26, p. 38). The June total of 227,032 passengers in both directions represents a 6% increase over June, 1960. Eastbound total was up 3%, westbound total up 12%.

But the capacity increase for the month was 45% to 429,188 seats, resulting in a load factor of 52%. Load factor for June, 1960 was 72%.

### Eastbound Load Factor

Eastbound load factor last month was 65%, with a total of 140,040 passengers and 215,288 seats. This compares with a lush 90% eastbound in June, 1960. High peak season loads have historically been relied upon to pay most of the bills for the rest of the year.

Traffic in early July reportedly was running about the same as in June.

First-class traffic plunged to 26,294 passengers last month, down 26% from last June's total. Last month's economy passenger total was 200,738, an increase of 12% over June, 1960. During the 1960 month, the North Atlantic's last tourist-class passengers were carried, totaling 979.

One reason cited for the economically painful drop in first-class traffic is the policy of many business companies to send their executives economy class. The jet itself, in addition to economy measures, is a factor in this shift. Increased speed and comfort over lengthy piston flights means that the executive can arrive relatively fresh for a business day in either class. In piston days, he often required a berth for the longer hauls.

Shift in the proportion of economy to first-class seats is one factor in the over-all surge in transatlantic seating capacity. The carriers offered 50% more economy seats last month than in the previous June, while first-class capacity increased 23%.

First-class traffic has been dropping in U. S. domestic service, too, though not so drastically (AW July 24, p. 40).

Some airline officials believe that, barring an unlikely reduction in total capacity, lower fares are the only answer to the transatlantic situation. These officials believe that the market is simply running out of growth potential at present levels. It is difficult to find a carrier that publicly opposes fare reductions. But resistance is based in part on the question of whether significant reductions are economically justified. In this view, it is doubtful whether lower fares would raise volume enough to compensate for the reduced revenues.

Meanwhile, the carriers' woes are not assuaged by the strong trend to late bookings exhibited by transatlantic passengers. This usually makes the situation a week or two ahead look much worse than it ultimately turns out to be. With the abundance of capacity, passengers are taking the preferred weekend flights and deepening the midweek traffic valleys. As a move to meet this situation, carriers are consolidating some midweek schedules. This cuts down the flying of nearly empty aircraft, but the expensive planes are not earning any revenue to pay for other expenses while they are on the ground.

## Eastbound North Atlantic Traffic

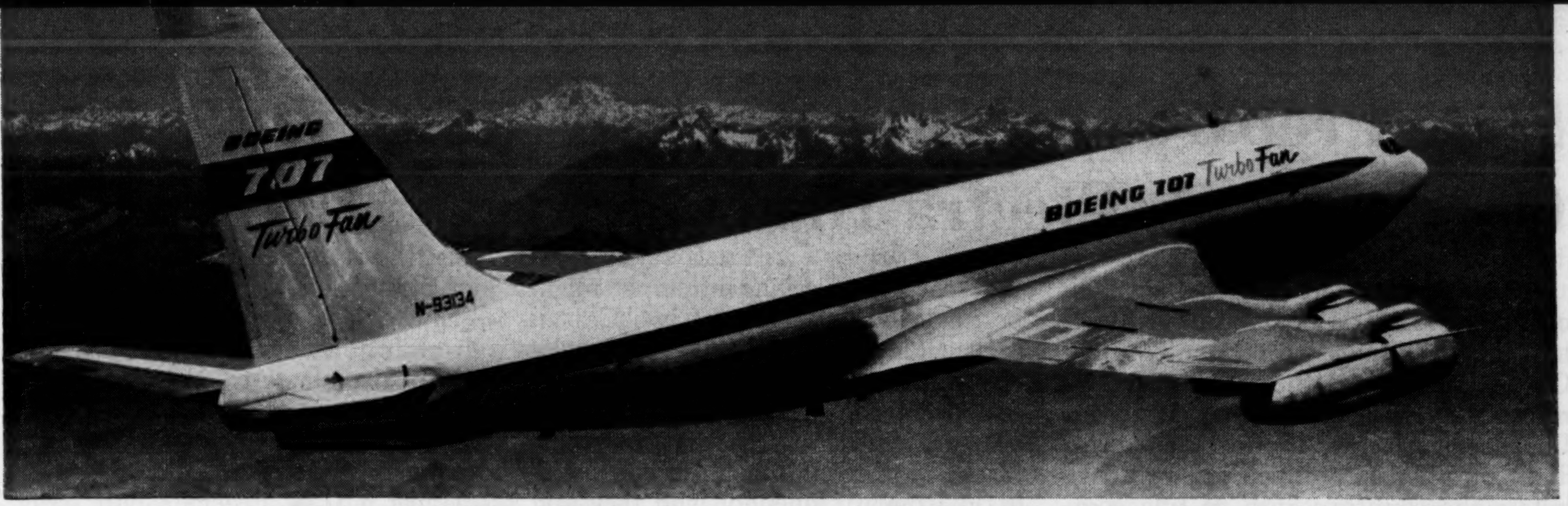
(June 4—July 1)

| | Flights | Seats | Passengers | Load Factor |
|---|---|---|---|---|
| Air France | 124 | 17,552 | 10,423 | 59% |
| Air-India | 19 | 2,496 | 1,234 | 49 |
| Alitalia | 69 | 9,084 | 6,346 | 70 |
| BOAC | 240 | 30,528 | 19,390 | 64 |
| Canadian Pacific | 37 | 4,352 | 2,496 | 57 |
| Lufthansa | 89 | 12,530 | 9,094 | 73 |
| El Al | 31 | 3,403 | 2,693 | 79 |
| Iberia | 13 | 1,070 | 658 | 61 |
| Irish | 38 | 4,610 | 3,713 | 80 |
| KLM | 125 | 13,931 | 9,824 | 71 |
| PanAm | 327 | 40,521 | 27,157 | 67 |
| Qantas | 8 | 736 | 317 | 43 |
| Sabena | 60 | 8,382 | 4,717 | 56 |
| SAS | 107 | 13,899 | 10,849 | 78 |
| Swissair | 63 | 8,080 | 5,425 | 67 |
| Trans Canada | 83 | 10,534 | 6,472 | 61 |
| TWA | 162 | 22,355 | 15,133 | 68 |
| Totals: | 1,595 | 204,063 | 135,941 | 67% |

# Continental's Profit Tied to Cost Control

Continental Airlines earned a net profit of $542,000 for the first six months of 1961, up from a net of $515,000 in the same period of last year. Tight cost controls were cited as the reason for the favorable result.

Total operating income for the 1961 period was $2,463,000, down from $2,618,000 in the first half of 1960. Utilization of Continental's Boeing 707-120 jets averages 14 hr. 48 min. daily, Continental said. System-wide break-even load factor for the first half of 1961 was 43.8, compared with 45.8 for the first half of 1960.



**Qantas 707-138B Completes FAA Certification**

**First of four Boeing 707-138Bs ordered by Qantas Empire Airways has completed Federal Aviation Agency certification and is being prepared for delivery to the Australian carrier. The aircraft, which is powered by Pratt & Whitney JT3D turbofans, has a fuselage length of 128 ft. 10 in., 10 ft. shorter than the standard 707-120, in order to increase the range of the transport. Seven Qantas 707-138s will be returned to Boeing this summer for modification to turbofan configuration.**

# FAA Denies That Midair Collision Forced Traffic Control Changes

**Washington** – Federal Aviation Agency has denied that its Air Traffic Control procedures and personnel contributed to the Dec. 16 midair collision over New York, but the agency admits that the accident lent "impetus" to a subsequent series of traffic control changes.

During the second stage of Civil Aeronautics Board hearings on the cause of the accident, George E. Robertson, Washington representative on FAA's internal investigating team, testified the changes were precautionary moves designed to eliminate the "sequence of events" that led to the midair collision between a United Air Lines DC-8 and a TWA Super Constellation. Responding to questions posed by the Air Line Pilots Assn., Robertson said FAA had:

- **Scrapped the General Railway Signal** (GRS) light system used to transfer control of inbound aircraft from Idlewild airport's Air Route Traffic Control Center to Approach Control in the Idlewild tower. FAA had no complaint with the mechanical system, but stopped using the lights because controllers conceivably could operate them incorrectly, Robertson said.
- **Broadened the use of radar** handoffs between center and approach control at Idlewild. Robertson said radar handoffs always have been FAA's objective at Idlewild and that the accident "added to the impetus toward reaching our objective."
- **Abolished the shortcut** routing followed by the United DC-8 en route to the Preston VOR intersection, the fix it overshot just before colliding with the Super Constellation. This shortcut routing, according to Robertson, "could have contributed to what occurred."

Testimony of 25 witnesses at the hearing centered on technical subjects, such as the general theory of radio wave reflection, design problems associated with the DC-8's VOR antenna installation and the possible effect of electronic industrial noise on VOR signals in the New York area at the time of the accident.

On electronic noise interference, William L. Kiser, Federal Communications Commission engineer in charge of the New York area office, told the CAB that noise levels sufficiently high to affect VOR signal reception had been measured "a great many times" in the vicinity of New York City.

There are about 275 plants in the metropolitan New York area, each with an average of 10 machines that use radio energy to seal various articles made of plastics, Kiser said. Terming this "gypsy" industry "very uncooperative," he said that 11 New York area plants had been served temporary restraining or cease and desist orders obtained in court by FCC during the year ending June 30, 1961. Machines operated by these plants generated "harmonic emissions" that cause erratic deflection of the VOR course indicator in an aircraft's cockpit.

According to witness Floyd Iden, executive engineer with International Telephone & Telegraph's Aerospace Laboratory, three objects near the Colts Neck VOR transmitter—a low frame house, a barn with a sheet metal roof and a ham radio antenna—may have produced "signal abnormalities." But Iden indicated that the probability of this happening at the time of the accident or just before it was very low.

Trees, barns and common antennas within 500 ft. of a transmitter could result in wavy or scallop-like courses, William C. Jackson, chief of FAA's development division, told the CAB panel. However, Jackson indicated that this sort of irregularity was minor in nature and probably could not have accounted for the DC-8's overshooting its assigned fix by 11 mi.

When the hearing adjourned after its 10th full day, CAB Member G. Joseph Minetti advised that interested parties had 30 days in which to submit written interpretations of the accident's probable cause as indicated by the evidence. CAB officials predicted privately the Board won't issue its finding for six months or perhaps not for a year.

## European Heliports

**London—Development of city-center helicopter service between London, Brussels and Paris will be a joint undertaking by British European Airways and Sabena, involving purchase of five Boeing-Vertol 107s (AW July 10 p. 33).**

**Still undetermined is allocation of the Vertols, i.e., three to Sabena and two to BEA, or vice versa. Decision will be made soon by the Ministry of Aviation for referral to the Exchequer. Air France is involved, at the moment, as an "interested observer."**

**BEA currently is studying the selection of a suitable heliport, and even is considering the possibility of utilizing a surplus carrier moored in the Thames. Parliamentary committee, after two years of study, last week recommended three Thames River sites, two near Tower Bridge and the third near Vauxhall Bridge, as possibilities. All involve extensive construction costs.**

**Vertols are considered interim equipment to the Westland Rotodyne production decision. BEA would use the Mark 2 Rotodyne—a 70-seater using Rolls-Royce Tyne turboprops. Aircraft is still in the design stage. Vertols would be powered by de Havilland Gnomes.**

# State Prepares for Bargaining Over Cuban's Electra Hijacking

**Washington**—State Department officials prepared for a new round of tough bargaining sessions with Premier Fidel Castro last week in the wake of Cuba's refusal to return an Eastern Air Lines Lockheed Electra commandeered in flight by a Cuban gunman just two days before the country's 26th of July commemoration of the Castro revolution.

The aircraft's 32 passengers and five crew members, who were en-route from Miami to Tampa and Dallas when the flight was diverted, were released by Castro the following day on a special Pan American World Airways flight. But he issued a blunt ultimatum that return of the turboprop aircraft would depend on the outcome of negotiations for the exchange of 10 Cuban aircraft impounded in the U. S. for nonpayment of bills incurred by the Cuban government.

U. S. diplomatic attempts to recover the aircraft through negotiations started last week by the Swiss Embassy in Havana brought no immediate reply as Cuban officials occupied themselves with a four-day celebration program, at which Soviet Cosmonaut Yuri Gagarin was guest of honor.

Airlines serving the Southeast immediately adopted strong security measures to avoid the hijacking of any additional aircraft after being warned by the Federal Bureau of Investigation that diversion of the Eastern aircraft was part of a Cuban plot to steal five more transports in retaliation for the impounding and sale of Cuban aircraft under a court order granted the Harris Advertising Agency of Miami.

The airlines said the FBI advised that further hijacking attempts might be made by five teams of two Cubans each. The FBI said the piracy plot was uncovered recently in New York, and the Justice Department later filed charges, in absentia, against a 36-yr.-old Miami waiter of Cuban origin, Wilfredo Roman Oquendo, who they said boarded the Eastern flight at Miami under the name of Jose Marin.

### BOAC Deficit

**Final financial results of British Overseas Airways Corp. show a deficit of $5,554,827, somewhat more than indicated in provisional results because of larger than expected deficits of subsidiary corporations.**

**Operating profit was $11,939,813 after depreciation provision of $27 million. Interest payments of $13,264,006 produced a deficit of $1,324,193. Inclusion of losses of $5,799,791 by subsidiaries and a special credit of $1,569,156 from adjustments to previous years' accounts produces the total deficit. The corporation's accumulated deficit rose to $41,580,915.**

**Last year BOAC reported an operating profit of $777,876 and a total deficit after interest payments and losses of subsidiaries of $2,334,626.**

Other than warning the airlines and airports to be on the alert for more possible hijackings, the FAA said it had taken no further action. FBI spokesmen emphasized that the bureau is not providing any aid in the form of armed guards or arrests at airports, but clearly indicated that advisory support is being given.

Delta Air Lines, however, admitted that passengers boarding a northbound flight from Havana the day after the Eastern incident had been thoroughly screened and questioned. Delta spokesmen said a southbound flight scheduled the following day for Cuba had been canceled and that they were not certain whether the preflight questioning of passengers was being applied at other points on the Delta system.

Reports also persisted that some carriers directed flight crews to lock the cockpit door as a precautionary measure, while other airlines rejected the idea on the premise that it might cause added violence.

Pan American World Airways expressed confidence that its aircraft would not be touched by the Cubans, who have stated that scheduled flights entering Havana will not be molested. The airline earlier had established a special schedule of 10 daily flights between Havana and Miami under Cuban approval for the airlift of Cubans desiring to leave the country. This schedule was cut to two a day by Castro, the airline said, and all airlift operations were later canceled because of the July 26 celebration program.

Cubana Airlines, which was the target of an attempt by the Harris Advertising Agency last September to impound two Bristol Britannia turboprop transports used to carry a Cuban delegation to the United Nations sessions, denied any knowledge of the impoundment of Cuban aircraft in the U. S. and later announced that it was canceling its weekly Super Constellation service between New York and Miami.

Attorneys for the Cuban airline, who fought the impounding attempt, said that action to get the first Britannia was vacated by New York courts on grounds that the aircraft was registered in the name of Cubana, while the legal action was directed against the Cuban government. Legal action to attach the second aircraft, which resulted in Castro returning home on a Soviet turbojet aircraft, was withdrawn after intervention of the State Department, they said.

Erwin Harris, president of the Miami advertising agency, replied that the British manufacturer also had intervened in the attachment attempt by demanding back payments of $400,000 overdue on the two aircraft.

Under a U. S. Federal Court order, 10 other Cuban planes have been impounded, of which nine have already been sold to satisfy an outstanding bill of $429,000 for services which Harris said his firm performed for the Cuban Tourist Commission in 1959. Impounded at Miami, Key West and Marathon, Fla., the aircraft included five C-46 cargo aircraft, which brought an average of $8,000 each; three Piper Cubs at $1,000 each and a DC-3 which brought $19,000. The remaining aircraft, a Cessna-180, bearing military markings and recovered from a Cuban military defector, will be sold this week.

News of the commandeering of the Eastern aircraft triggered a series of indignant reactions from Congress the following day, with several senators and congressmen favoring an immediate ultimatum to Castro to either return the airliner and passengers within 24 hr. or face the prospect that U. S. military force would intervene.

# CAB Is Investigating Competition for United

**Washington**—Civil Aeronautics Board is investigating United Air Lines' lack of competition between four pairs of cities resulting from its merger with Capital Airlines.

The Board, while noting that its action "does not imply doubt concerning the wisdom of our decision in the United-Capital Merger Case," instituted the investigation to determine which of several carriers should be authorized to operate in competition with United.

CAB has decided to investigate service to pairs of cities formerly served by United and Capital generating more than 100 passengers per day. Traffic data for these cities must also indicate that Capital was an effective competitor.

After screening 19 pairs of points in which United no longer has competition, the Board decided to investigate adequacy of service between Cleveland and New York, Cleveland and Chicago, Cleveland and Philadelphia and Philadelphia and Detroit.

The Board has named Allegheny, American, Lake Central, Mohawk, Northwest, TWA and United as parties to the investigation.

# Disagreement Spurs Foreign Policy Study

By L. L. Doty

**Washington**—Proposed White House plans to launch a wide-scale research study of international air transportation now appear to stem from a general disagreement within industry and the government over what steps should be taken to strengthen the U. S. position in international aviation.

In the past, the principal clash has been between industry and government over the policy the U. S. should follow in the conduct of overseas airline operations. But recently, the State Department's firm stand on commercial issues in the negotiation of bilateral air transport agreements has mollified the carriers to a large degree.

Nevertheless, major U. S. international airlines have failed to see eye to eye on a number of issues, particularly when the competitive factor plays a significant role, and the splits in opinion are not diminishing. At the same time, a number of departments within the executive branch of the government, prompted by congressional pressure, are currently jockeying for leading positions in final formulation of a policy that will guide the U. S. in sustaining its commanding position in air transportation.

This struggle for dominance inevitably has produced a number of theories, many of which contradict one another. Thus the need for a research study that will form the basis for a long-range, firm policy has emerged.

## Transportation Message

President Kennedy was to have called for such a study in a message to Congress last spring on the over-all transportation situation. In the message, which was drafted by the Commerce Department but which was deferred by the White House until next year because of more pressing international problems, he was to have asked for a "re-examination in realistic terms of the conditions upon which our reciprocal international air commerce is founded."

The report to be released soon by the White House Project Horizon task force, which is highly critical of the political overtones involved in the negotiation of bilateral agreements, will recommend a year-long study of international aviation. The State Department now is conducting a study on the same subject.

In recent months, Civil Aeronautics Board Chairman Alan S. Boyd has asked for a re-evaluation of the Bermuda principles, the formula on which the great majority of U. S. bilateral air service agreements is based. In any research study undertaken by the White House, the CAB will take a leading part in the project, although Federal Aviation Agency Administrator N. E. Halaby, as special assistant to the President for aviation, probably will be assigned to direct the program.

One of the chief criticisms of previous studies conducted on international air transport has been that researchers have failed to make a clean break with the past and to develop a fresh policy that is based on the expected future status of air transportation. The Bermuda principles, which evolved during negotiations between the U. S. and Great Britain on a bilateral air transport agreement in 1946, are a main target.

In discussions with industry and government officials close to international air transport, Aviation Week has found that there is almost unanimous opinion that the Bermuda principles have become outmoded and are no longer effective in controlling the reciprocal exchange of traffic and routes. There are some who would eliminate the Bermuda principles entirely and replace them with more modern formulas.

The majority, however, prefers to see the principles rewritten to erase the ambiguities which, it is claimed, are the prime source of the wide-ranging interpretations causing the current dissension between the U. S. and a growing number of foreign nations. This group wants the principles written in tighter language that would leave no room for misconstruing the terms of an agreement.

Because the Bermuda principles were a compromise between the protectionist policy of Great Britain and the open competition policy of the U. S., they have been subjected to a wide variety of definitions.

It is now clear that U. S. airlines are advocating the restrictionist policy once supported by the majority of European nations, which, in turn, are now opposed to control, particularly in North Atlantic markets. Since U. S. carriers are generally backed by most government agencies and departments in their drive for control of capacity and traffic, it is very likely that a protectionist approach will form the backbone of any proposed new international policy.

There is general agreement that future policy must be based on the prospective growth of air transportation, but here again, there is a lack of accord on what that growth will be, not so much in terms of traffic growth, but in the development of route patterns and in the change of traffic flow. Many observers feel that within the next two decades, route systems will undergo drastic changes, new international gateways will supplement if not supplant today's popular gateways and traffic markets will spread into areas not now served by airlines in any large volume.

## Future Policy

These assumptions take into account the following conjectures as a basis for a future long-range air transport policy:

- **Range of transport aircraft** will, for all practical purposes, be unlimited. Operating techniques, aircraft speed and range, have already permitted the use of new gateways on international routes and the expansion of operations over time-saving great circle routes.
- **While not expected** in the immediate future, communist nations of Europe will gradually lift restrictions against commercial operations over all but a limited number of air corridors. It is reasonable to believe that Russia will open its trans-Siberian route to foreign flag carriers to permit the use of a polar route between Moscow and Tokyo or even London and Tokyo.
- **Just as Russia opened** its air routes to Moscow to the Scandinavian countries, France, Holland, Belgium and the United Kingdom, so can Red China be expected to open its frontiers to air services in Canton, Peking or Shanghai, although this is far from imminent.
- **Airline pooling will emerge** as a major factor in airline operations.

Assuming that these conjectures materialize into fact, there will be seven major route segments in the world:

The transatlantic routes, both north and south; North America-South America; a polar route between the U. S. West Coast and central Europe and as far west as India via Moscow; transpacific great circle routes, including a route from the U. S. East Coast via Alaska and Manchuria to Peking or Canton; a northern route between Western Europe and Japan across the top of Siberia; a central route from Western Europe to Peking via Moscow and Novosibirsk, and a southern route connecting North America and Western Europe with the Far East and Australia similar to that now flown on all east-west operations conducted by airlines outside the Iron Curtain.

The flow of air services within Africa and between Africa and Europe including the Soviet Union will increase steadily with flag carriers of African nations, operating in pools, playing a leading role. How extensive an operation the U. S. will conduct from the U. S. to major parts of Africa will depend almost entirely on the degree to which the U. S. will be willing to subsidize such services.

# AIRLINE OBSERVER

▶ Russian press coverage of the United Air Lines DC-8 accident at Denver on July 11 and the Czechoslovakia Airlines Il-18 crash at Casablanca, Morocco, on July 12 again illustrates the double standard in Soviet news reporting. Story of the United crash, which killed 17, appeared in Izvestia's front page in boldface type, and it was emphasized that an "American-built DC-8 jet" was involved. Report on the Czechoslovakia Airlines accident, in which 72 were killed, was buried on Pravda's back page in small type. Fact that a Russian-built Il-18 turboprop transport was involved and that a number of Soviet citizens were killed was not mentioned by Pravda.

**▶ Legislation drafted by the Civil Aeronautics Board to make all domestic trunkline carriers ineligible to receive subsidy has been introduced by Sen. Warren G. Magnuson (D.-Wash.). The Board believes that the position of the domestic airlines has improved sufficiently so that it is no longer realistic for them to assume they can rely on government subsidy. The bill applies to all intrastate and interstate trunkline operations but those in Hawaii and Alaska.**

▶ Cunard Eagle Airways is delaying its application to Civil Aeronautics Board for a London-New York foreign air carrier permit pending disposition of an appeal filed with the British Minister of Aviation by British Overseas Airways Corp. (AW July 3, p. 39). The BOAC appeal, charging substantial and wasteful diversion of traffic will result, is to be heard in early September by Sir Fred Pritchard, retired high court justice.

**▶ Preliminary investigation of the KLM Douglas DC-8, operated for Viasa, which crashed off Portugal (AW June 19, p. 49) has led Dutch technicians to suspect the aircraft's fuel tanks may have been filled with a mixture of JP-4 or gasoline and kerosene. Some authorities believe that mixed fuels have a greater tendency to explode than pure kerosene. The DC-8 apparently struck the water at about a 70-deg. angle.**

▶ Defense Air Transportation Administration plans to include carriers flying Logair and Quicktrans contracts awarded by Military Air Transport Service in the Civil Reserve Air Fleet. This would ensure that freighters flown by Logair and Quicktrans contractors would be available to the Air Force in times of national emergency.

**▶ Federal Communications Commission has empowered its field inspectors to shut down industrial plants "on the spot" if the plant's industrial electronics noise level interferes with VOR signal propagation. Prior to this new policy, FCC obtained cease and desist or temporary restraining orders in court to halt activity at offending plants. Maximum permissible noise level within a one-mile radius of a plant is 10 microvolts, unless air navigation aid interference can be proved at a lower level.**

▶ Civil Aeronautics Board has instituted an investigation to determine whether a U.S. carrier should be authorized to provide nonstop service between New York and Jamaica. Three foreign flag carriers—BOAC, BWIA and Avianca—currently are permitted to offer this service, but neither Delta nor Pan American, the two U.S. airlines serving Jamaica, hold nonstop rights. U.S. received authority to operate nonstop in an agreement signed with the United Kingdom in June. The Board has noted that traffic between Jamaica and the U.S. increased 195% between 1955 and 1960, and that an estimated 80% of all passengers arriving in Jamaica originate in the U.S.

**▶ American Airlines has charged that diversion of regular coach traffic resulting from TWA's proposed transcontinental excursion fare (AW July 24, p. 40) will be "financially crippling." In a complaint filed with the Civil Aeronautics Board, American said that for every five passengers diverted, two new passengers must be attracted to replace revenues lost from the diversion. American filed for the excursion rate for "competitive purposes only."**

## SHORTLINES

▶ **Alitalia** flew 34,416 passengers across the North Atlantic during the first six months of 1961, an 87.9% increase over the same period last year.

▶ **British Overseas Airways Corp.** has opened a Miami office to represent BOAC, British West Indies Airways and Bahamas Airways.

▶ **Caribbean Atlantic Airlines'** stewardesses have voted to remain in the Transport Workers Union Air Lines Stewards and Stewardesses Assn. rather than join the Air Line Pilots Assn.

▶ **Civil Aeronautics Board** has asked 22 parties interested in the Board's proposal to revoke minimum freight rates to argue Aug. 4 whether the rates should be revoked or a formal rate hearing begun.

▶ **Compania de Aviacion "Faucett,"** a Peruvian airline, has been recommended for a five-year foreign air carrier permit to operate between Peru and Miami via Panama City by Civil Aeronautics Board Examiner Richard Walsh.

▶ **Continental Airlines** will begin nonstop Boeing 707 service between Los Angeles and El Paso Aug. 6.

▶ **Lake Central Airlines** reports it carried 41,134 passengers during June, a 79% gain over the same month last year.

▶ **Mohawk Airlines** has adopted a "Ready Ticket" system under which a regular passenger establishes credit, then receives a blank ticket book. The passenger makes his reservation, fills in his ticket, signs it and hands it to the stewardess. He is billed at the end of the month.

▶ **National Airways** of New Zealand is using turbine-powered Fokker F-27 aircraft for scenic flights. National formerly used DC-3s for this service.

▶ **Northwest Airlines** will add two Boeing 720B transcontinental flights Aug. 1. There will be daily round trips between Seattle/Tacoma and New York and between Portland and Baltimore/Washington, D. C. by way of intermediate stops.

▶ **Trans World Airlines** has received the first of 30 Boeing 720B turbofan aircraft, and deliveries are scheduled for completion by late fall, 1962. First four 720Bs will be leased for delivery by September. The rest will be purchased directly by TWA.

# Airlines Report Officers' Salaries

**Washington**—Following is a list of airline officers' salaries, bonuses and indirect compensation, expenses, and stockholdings for the year ending Dec. 31, 1960, as filed with the CAB.

**Aloha Airlines—R. F. Tongg,** chairman, $13,800 salary, 201,532 shares of preferred stock; **H. W. Ching,** president and director, $15,000 salary, 23,600 shares of common stock, 579,760 shares of preferred stock, $1,626 expenses; **K. F. Char,** executive vice president and director, $14,833 salary, 13,250 shares of preferred stock, $1,423 expenses; **J. M. Brown,** vice president-operations, $14,995 salary, no stock, $588 expenses; **R. H. King,** senior vice president-traffic and sales, $18,564 salary, no stock, $3,394 expenses. For services rendered 1960: **Harry A. Bowen,** legal, $10,150.

**Hawaiian Airlines—A. D. Lewis,** president and director, $37,750 salary, no stock, $20,754 expenses, $11,500 convertible debentures; **B. Cooke,** vice president-finance and director, $23,688 salary, 50 shares of common stock, $5,710 expenses, $1,900 convertible debentures; **L. D. Machado,** vice president-operations and director, $23,688 salary, 10 shares of common stock, $4,758 expenses, $1,800 convertible debentures; **J. C. Tobin,** vice president-sales, $23,428 salary, 125 shares of common stock, $11,242 expenses, $2,500 convertible debentures; **L. C. Conant,** vice president-industrial relations, $17,188 salary, 715 shares of common stock, $3,232 expenses, $3,800 convertible debentures; **W. M. Crilly,** vice president-planning, $17,188 salary, no stock, $6,969 expenses; **L. P. Irons,** assistant to vice president-finance (from Nov. 1, 1960), $11,923 salary, no stock, $1,342 expenses, $300 convertible debentures; **I. Matsunaga,** assistant treasurer-secretary, $9,950 salary, no stock, $530 expenses, $200 convertible debentures; **W. O. Richardson,** secretary-treasurer (from June 1, 1960), $12,417 salary, 50 shares of common stock, $3,630 expenses; **S. C. Kennedy,** chairman, $250 salary, 17,642 shares of common stock, $2,520 expenses; **H. L. Bair,** director, $250 salary, no stock, $100,000 convertible debentures; **R. D. Fraser,** director, $250 salary, 9,442 shares of common stock; **J. M. Greenwell,** director, $270 salary, 2,000 shares of common stock, $20 expenses, $3,000 convertible debentures; **C. Ho,** director, $250 salary, five shares of common stock, $3,300 convertible debentures; **D. C. Lewis,** director, $250 salary, 8,181 shares of common stock, 1,525 shares of common stock in the name of others, $161 expenses, $1,000 convertible debentures; **J. E. Russell,** director, $250 salary, no stock; **S. Takahashi,** director, $250 salary, 750 shares of common stock, $30 expenses, $5,000 convertible debentures; **H. W. White,** director, $270 salary, no stock, $20 expenses; **G. P. Wilcox,** director, $250 salary, 3,049 shares of common stock; **W. T. Beeke,** director, $250 salary, no stock, $1,353 expenses; **R. J. Behnke,** director, $250 salary, no stock, $977 expenses, $11,000 convertible debentures; **T. H. Smyth,** director, $250 salary, no stock, $504 expenses; **H. E. Clements,** director, $650 salary, 23,450 shares of common stock, $768 expenses; **R. S. Odell,** director, no salary, no stock; **H. F. Heep,** director (deceased 1960), no salary, no stock; **Dr. K. Kometani,** director (since Apr. 28, 1960), $250 salary, no stock; **Mrs. H. F. Heep,** director (Apr. 28-Oct. 28, 1960), $250 salary, $448 expenses, no stock, $328,000 convertible debentures.

For services rendered during 1960:

**Selig Altschul,** financial consultant, $5,168; **Gotch & Crawford,** planning consultant services, $10,681; **Pogue & Neal,** legal, $8,070; **Lewis, Buck & Saunders,** legal, $11,450; **Haskins & Sells,** audit, $6,608; **William C. Wold Associates,** commission on sale of DC-3, $7,187; **Verner & Bernhard,** legal, $6,044; **Turney & Turney,** legal, $33,686.

**AAXICO Airlines—H. J. Korth,** president, $96,000 salary, 44,332⅛ shares of common stock, $3,273 expenses; **J. G.**

**size problem:**

Package a power supply for the B-52G electrical system within stringent space requirements. Compensate for the bulky core insulation of conventional transformers. Clad the cores with epoxy potting capable of withstanding —65°C to 150°C.

**solution:**

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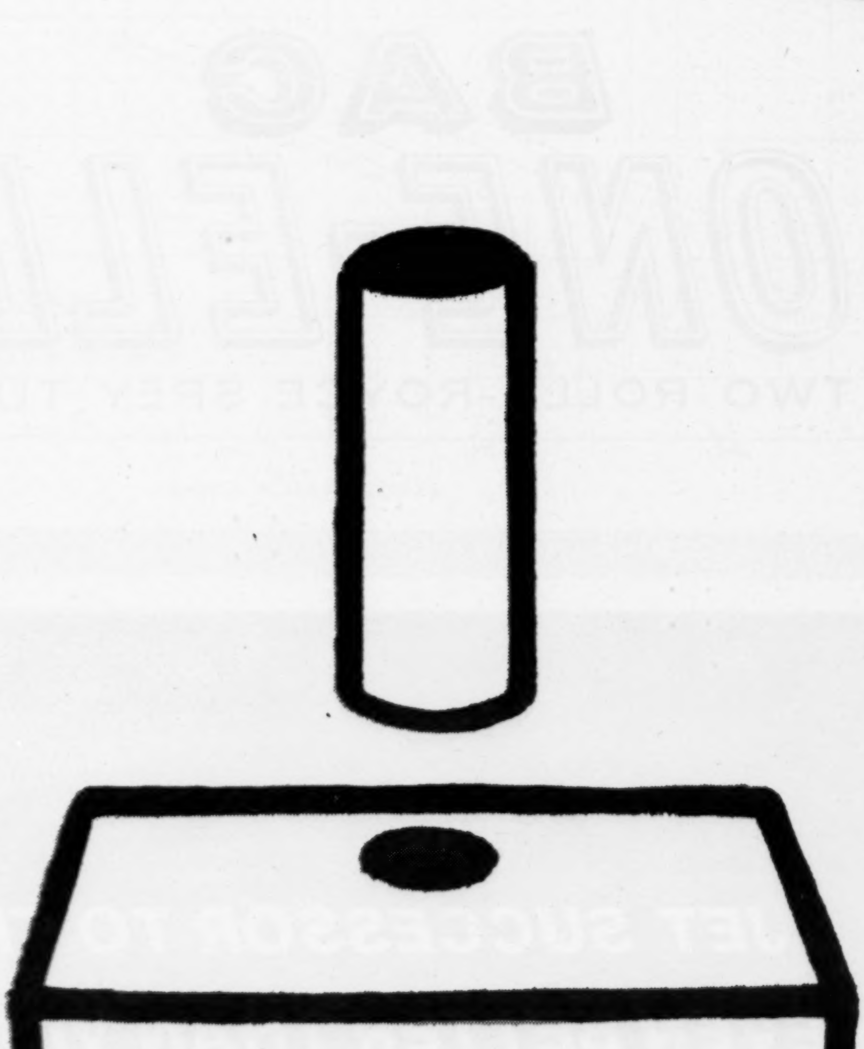
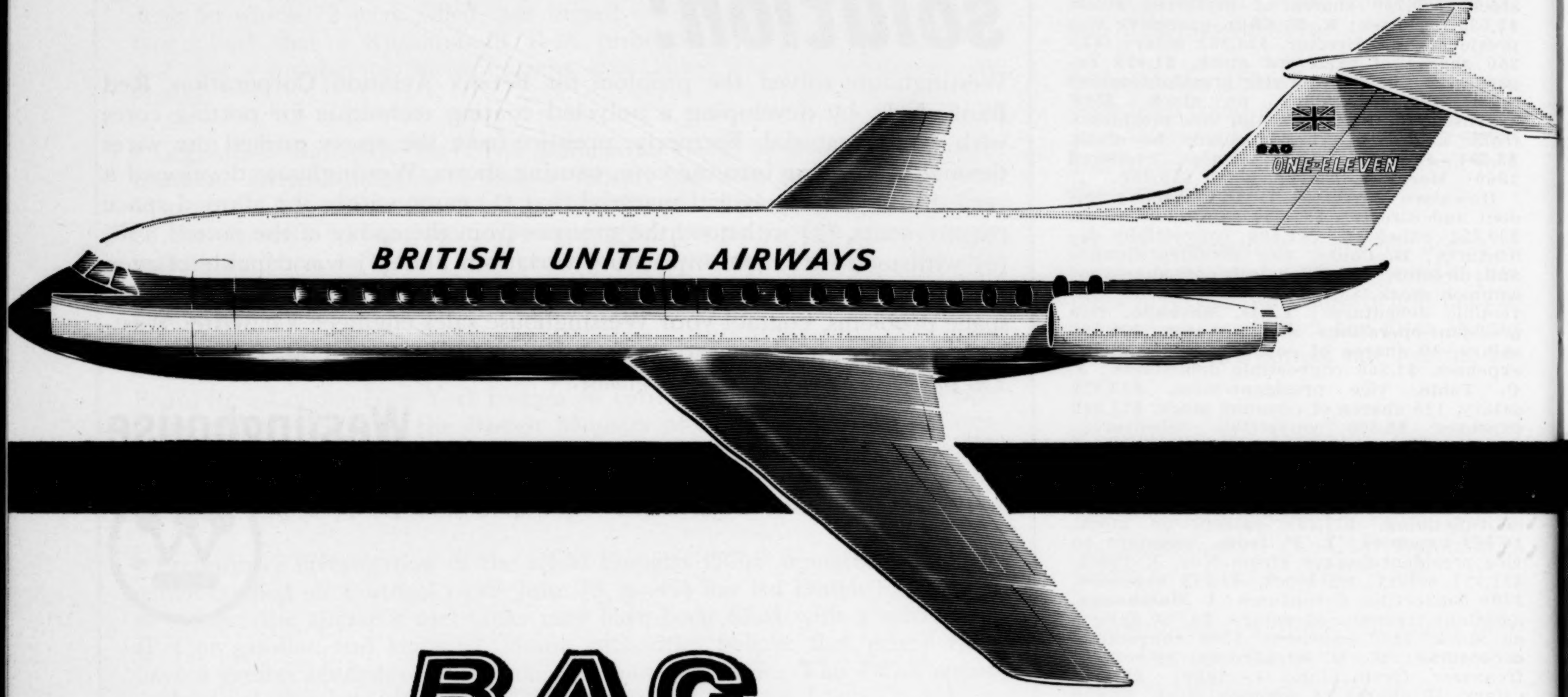
**Westinghouse**



**BRITISH UNITED**

**THE SHORT HAUL JET**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# AIRWAYS CHOOSES

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- 57 mixed class or 69 tourist passengers
- Short airfield performance
- Quick turn-round: built-in auxiliary power unit
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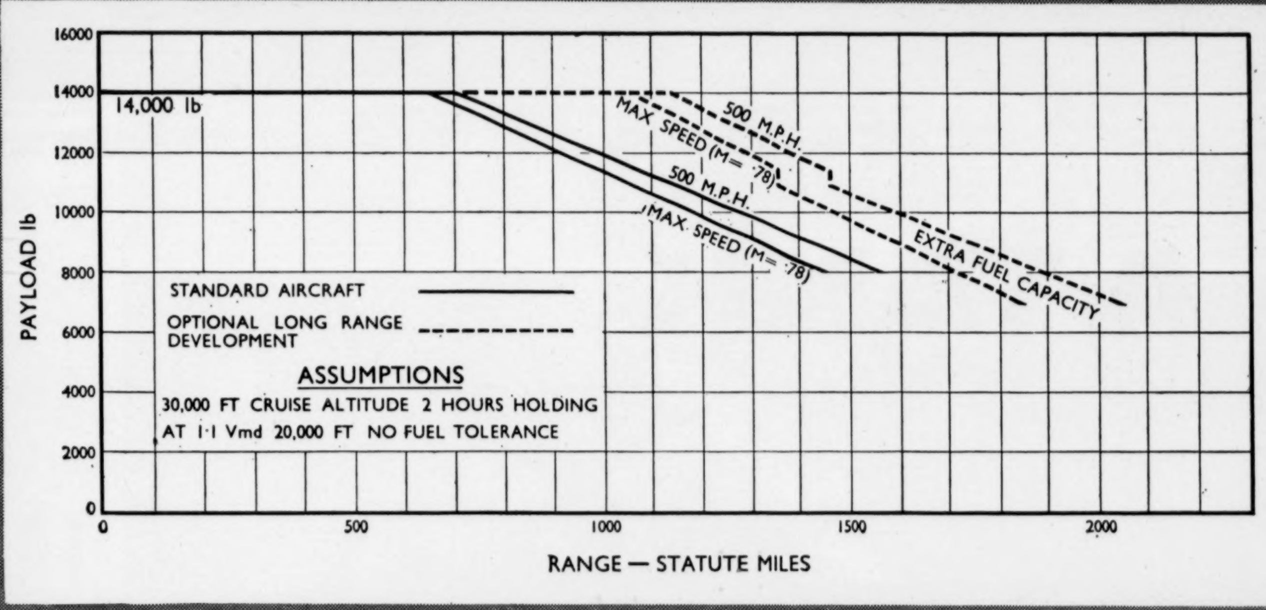
**BRITISH UNITED AIRWAYS HAS CHOSEN THE OPTIONAL LONG RANGE DEVELOPMENT OF THE STANDARD AIRCRAFT**

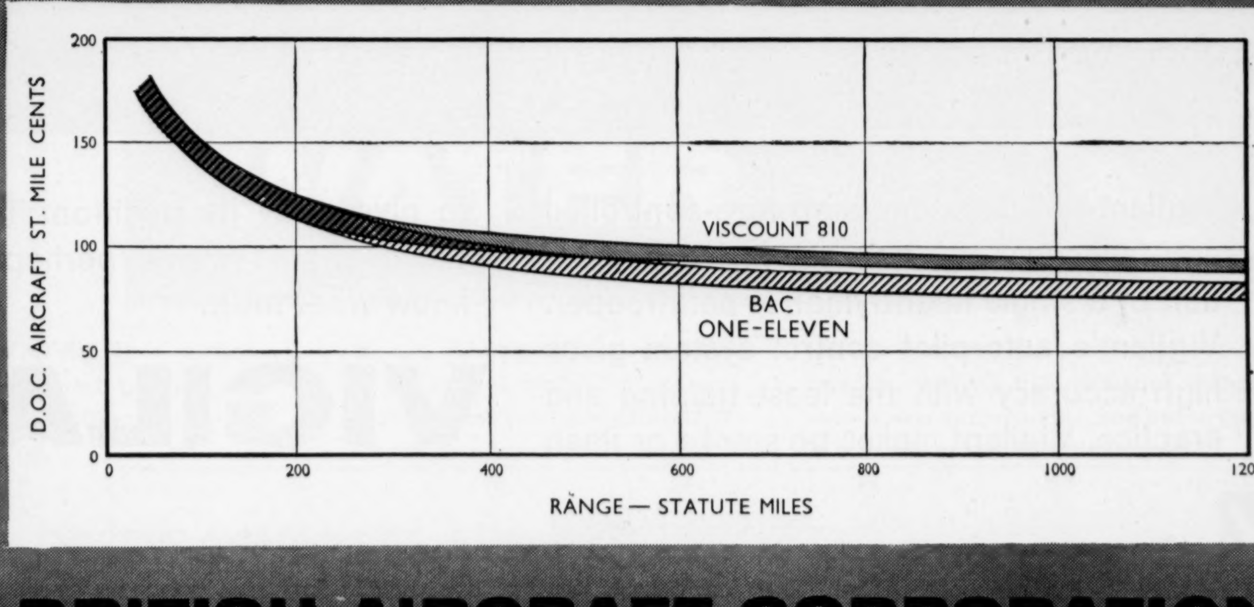
## PAYLOAD v. RANGE

The BAC One-Eleven can carry its full complement of 57 mixed class passengers and baggage at 500 mph for stages of 1,070 statute miles with two hours reserves. It can carry 43 passengers for 1,500 miles



## ECONOMICS

These bands cover seven separate methods of costing —ATA (1955), ATA (1960), SBAC and those of four airlines



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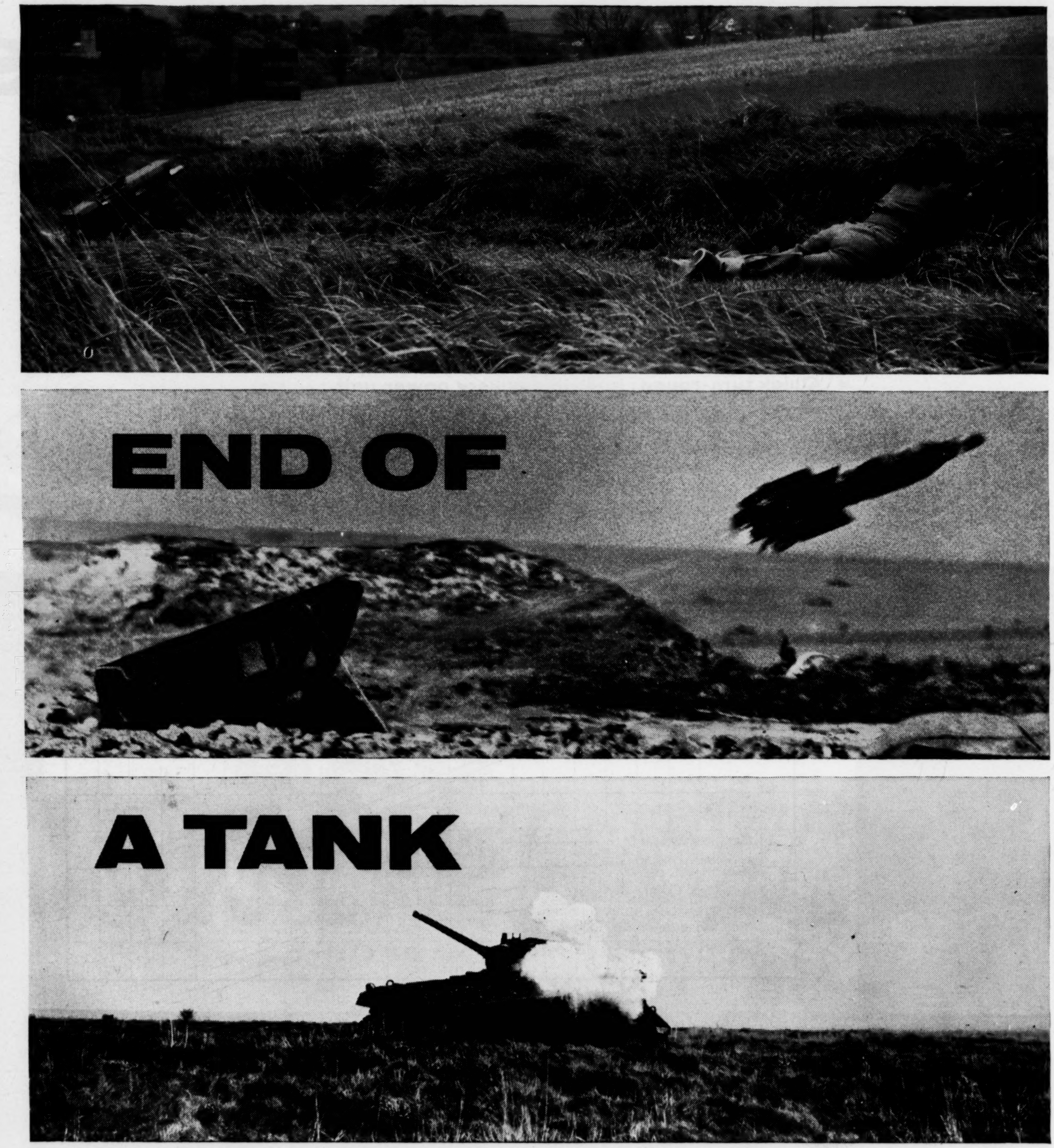

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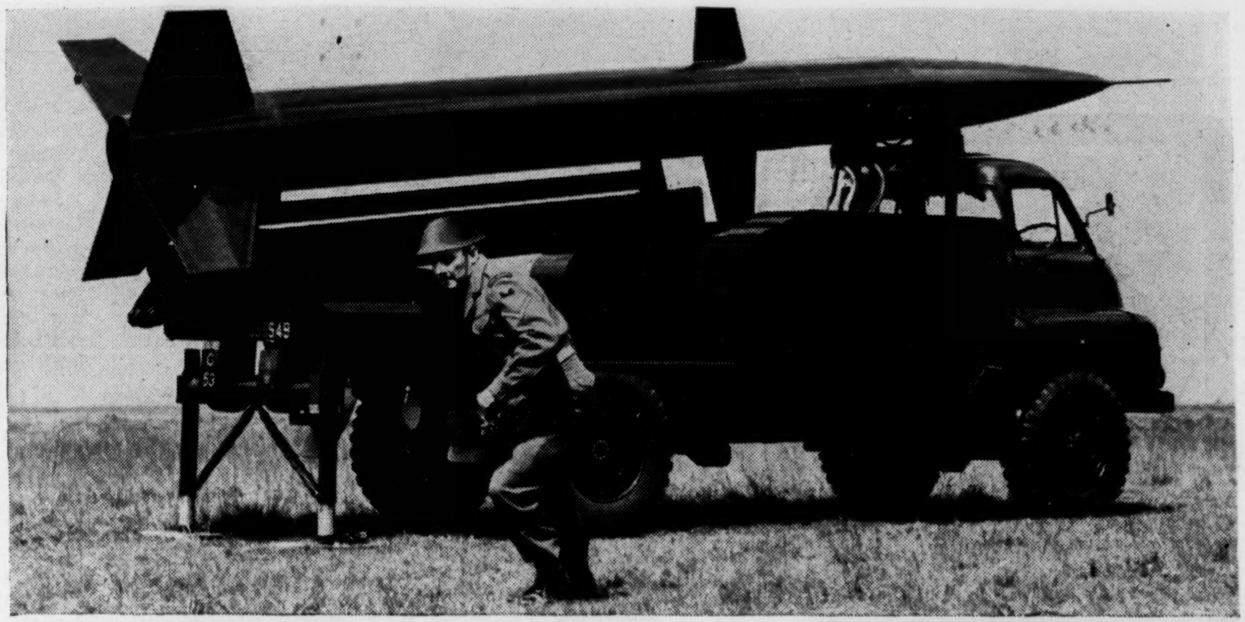
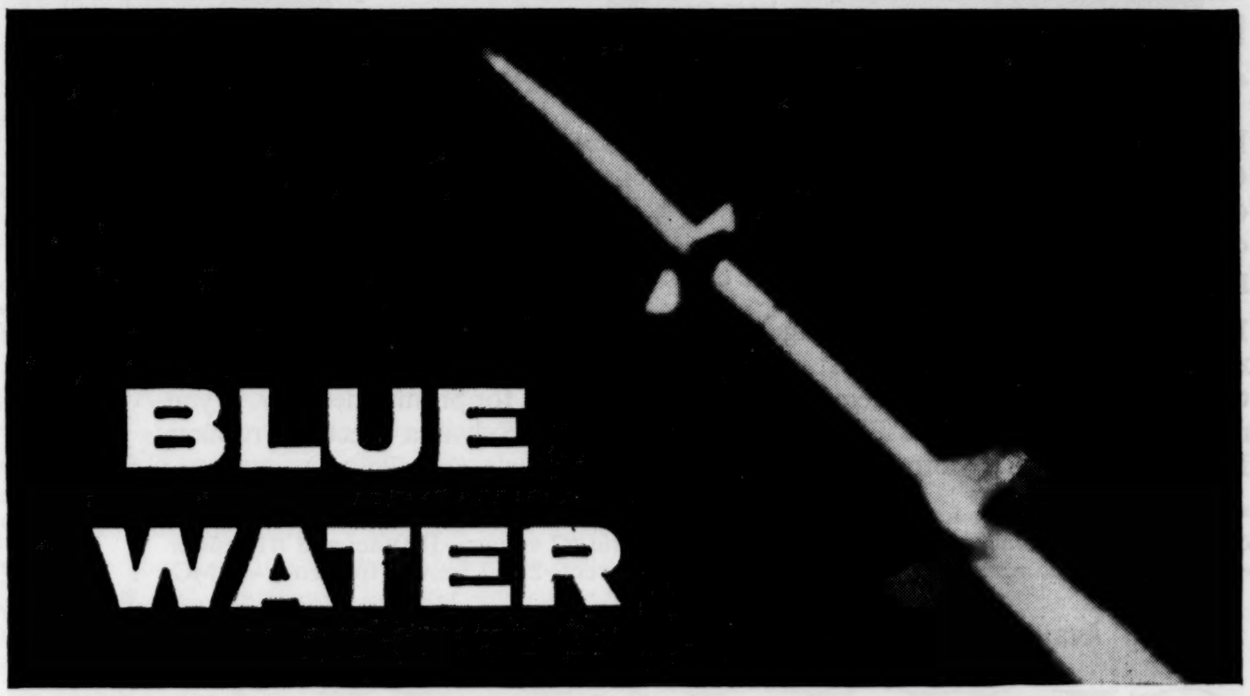
# COMPACT



# MOBILE

# LETHAL



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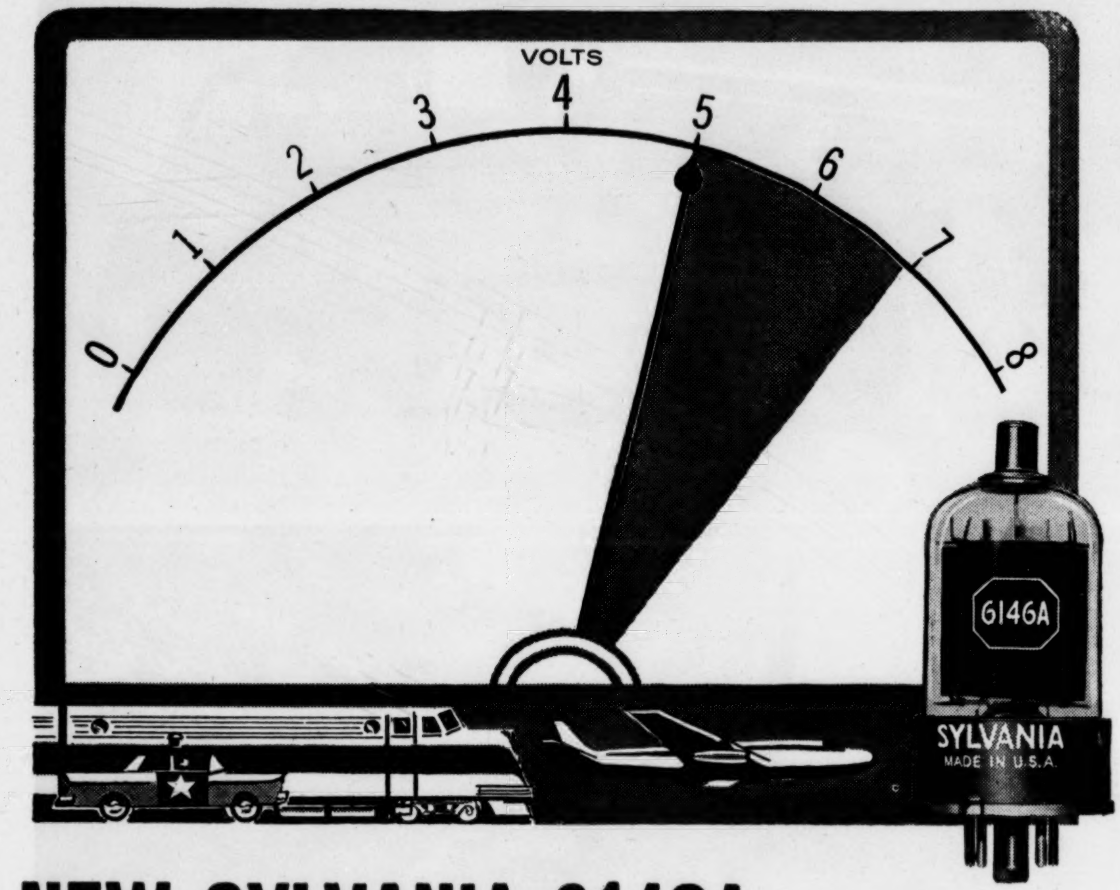

**NEW SYLVANIA-6146A maintains 45W output* with battery supply as low as 5 Volts**

RF amplifier output, Class C service—70W (ICAS) up to 60 MC 35W (ICAS) up to 175 MC

New Sylvania-6883A (12.6V type), 6159A (26.5V type) deliver 45W power at reduced A-supply of 10V and 21V, respectively

From Sylvania comes the first major performance improvement to the popular 6146 and its counterparts since their introduction 7 years ago. The new Sylvania-originated 6146A, 6883A, 6159A eliminate communications fade-out caused by decreased heater voltage supplies. They're unilaterally interchangeable with their prototypes—offering the same output capabilities at normal heater ratings.

If heater voltage regulation is plaguing your mobile or airborne communications, replace with the modern 6146A, 6883A, 6159A by Sylvania. Your Sylvania Industrial Tube Distributor has them in stock, now. Call him for prompt delivery. If you need technical data, write Electronic Tubes Division, Sylvania Electric Products Inc., 1100 Main St., Buffalo 9, New York.

*Minimum output limit for an individual tube (CCS) measured in a single-tube self-excited oscillator circuit. Conditions: plate voltage—600Vdc; grid #2 voltage—180Vdc; grid #1 resistor —30,000 Ohms; plate current—100 to 112mA; grid #1 current—2 to 2.5mAdc; frequency—15 MC.

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GENERAL SYSTEM

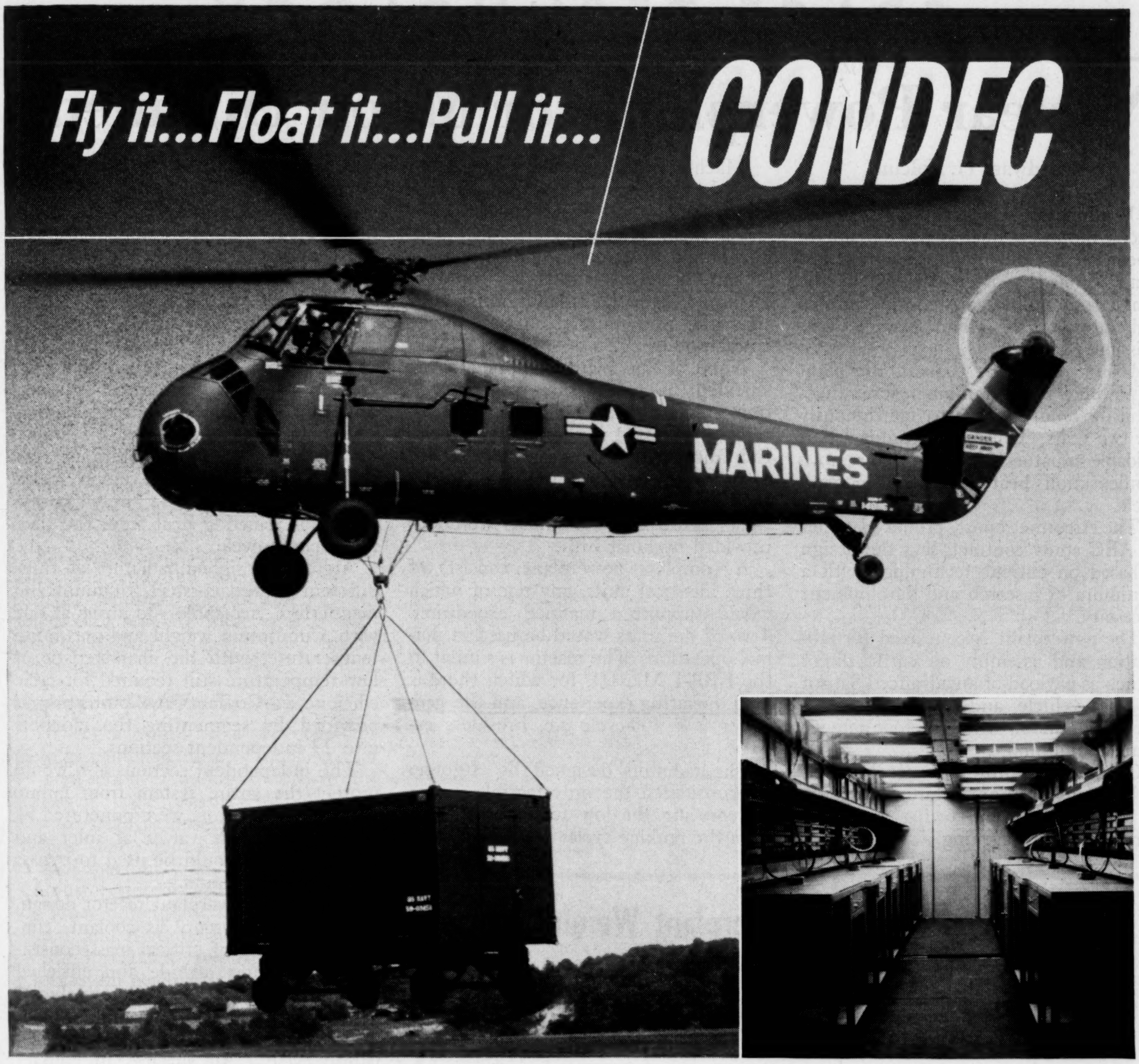
**Helvey**, vice president, $22,200 salary, no stock, $1,674 expenses, $11,525 bonus and indirect compensation; **E. P. Odenwalder**, secretary-treasurer, $13,200 salary, no stock, $817 expenses, $5,000 bonus and indirect compensation; **J. A. Young**, vice president, $12,025 salary, no stock, $411 expenses; **W. J. Korth**, director, no salary, 1,594⅛ shares of common stock; **S. J. Urban**, assistant secretary, $6,000 salary, no stock, $3,000 bonus and indirect compensation; **C. Lear**, assistant secretary, no salary, no stock. For services rendered during 1960: **Lear & Scoutt**, legal, $16,208.

**Flying Tiger Line—S. B. Mosher**, chairman, no salary, 30,607 shares of common stock, 818 shares of preferred stock, $300 bonus and indirect compensation; **R. W. Prescott**, president and director, $60,000 salary, 2,562 shares of common stock, $14,414 expenses; **R. Axe**, director, no salary, 1,000 shares of common stock, $388 expenses, $300 bonus and indirect compensation; **A. T. Chase**, director, no salary, 1,000 shares of common stock, $300 bonus and indirect compensation; **J. C. Cosgrove**, director, no salary, 1,078 shares of common stock, $200 bonus and indirect compensation; **B. Gresov**, director, no salary, no stock, 26 shares of common stock in the name of others, $1,050 expenses, $300 bonus and indirect compensation, $50,000 debentures held in the name of others; **A. Linkletter**, director, no salary, 1,000 shares of common stock, $200 bonus and indirect compensation; **C. Luckman**, director, no salary, 1,102 shares of common stock, $300 bonus and indirect compensation; **H. Rehrig**, director, no salary, 110 shares of common stock, $200 bonus and indirect compensation; **J. C. Tyler**, director, no salary, 1,530 shares of common stock, $200 bonus and indirect compensation; **F. Benninger**, vice president and treasurer, $35,000 salary, no stock, $6,923 expenses; **W. E. Bartling**, vice president, $19,800 salary, five shares of common stock, $2,140 expenses; **G. T. Cussen**, vice president, $14,000 salary, 10 shares of common stock, 33 shares of preferred stock, $3,320 expenses; **J. L. Higgins**, vice president, $25,000 salary, no stock, $3,894 expenses; **L. S. Kimball**, vice president, $14,400 salary, no stock, $7,063 expenses; **F. B. Lynott**, vice president, $32,000 salary, no stock, 120 shares of common stock in the name of others, $3,396 expenses; **G. S. Oberdorf**, vice president, $18,000 salary, no stock, $6,144 expenses; **O. R. Burghardt**, secretary-assistant treasurer, $21,600 salary, no stock, $205 expenses; **R. B. Stump**, assistant secretary, $14,400 salary, no stock, $60 expenses; **N. L. Meyers**, assistant secretary and director, no salary, 54 shares of common stock, eight shares of preferred stock, $152 expenses, $200 bonus and indirect compensation, $200,000 debentures.

Following firms were paid for services rendered during 1960: **Meyers & Batzell**, legal, $122,651; **Hill, Farrer & Burrill**, legal, $39,383; **Blum, Jolles, Haimoff, Szabad & Gersen**, legal, $17,478; **Channing Wallace & Gilson**, industrial design, $12,423; **Hixon & Jorgensen**, advertising, $19,014; **Arthur Andersen & Co.**, accounting, $23,725; **Signal Oil & Gas Co.**, promotional, $6,567.

**Mackey Airlines—J. C. Mackey**, president, $18,750 salary, 115,734 shares of common stock, $3,098 expenses; **J. H. Popham**, vice president secretary-treasurer and director, $14,500 salary, 10,001 shares of common stock, $282 expenses; **H. H. Johnson**, vice president-traffic and sales, $9,975 salary, 1,342 shares of common stock, $2,140 expenses; **R. C. Tischler**, vice president-operations, $14,500 salary, 10,148 shares of common stock; **L. J. Povey**, director, no salary, 1,745 shares of common stock, $282 expenses; **J. B. Fraser, Sr.**, director, no salary, 20,500 shares of common stock, $600 bonus and indirect compensation; **L. E. Mallory, III**, director, no salary, 3,056 shares of common stock, $174 expenses, $600 bonus and indirect compensation; **W. L. Kroetz**, director, no salary, 3,000 shares of common stock, $600 bonus and indirect compensation; **J. Kirkwood, Jr.**, director, no salary, 16,200 shares of common stock, $600 bonus and indirect compensation.

# Fly it...Float it...Pull it... CONDEC



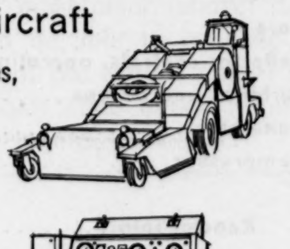
## Unitized, air-conditioned mobile shelters

Typical of Condec mobile shelters are these air-conditioned vans which can be joined in building-block fashion to provide any desired floor area. Transportable by land, sea and air, they provide comfortable working conditions from the Arctic to the tropics.

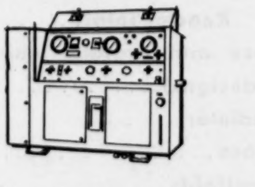
Fitted out as the electronic workshops shown here, they weigh less than 3,500 pounds. Equipment installed includes workbenches, instrument cabinets, outlets for 120/208-volt, 400-cycle AC and 28-volt DC, fluorescent lighting, emergency battery lighting, air-conditioning and heating.

The detachable, elevating undercarriage designed by Aircraft Equipment Division engineers adds a new connotation to the word "mobile." For loading in cargo planes, one crank elevates the body to platform height; four quarter-turn fasteners separate body from running gear, ready to be skidded aboard. When tow bar is released, brakes are automatically applied. Want to know how Condec can help you with your mobile shelter requirements? Call or write Mr. Jerome I. Davis, Vice President, Aircraft Equipment Division.

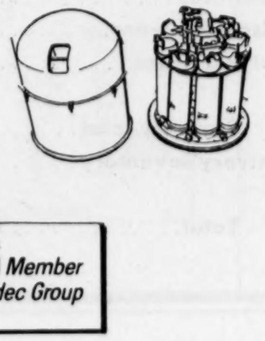
### Condec Products for Missiles and Aircraft



**Special-purpose vehicles,** like this runway sweeper, are key products at Consolidated Diesel. Other vehicles supply all power requirements for ground support of missiles and aircraft.



**Test equipment** covers entire range of systems to check hydraulic, pneumatic, electrical and mechanical operating parameters.



**Special airborne devices** include products like this radiosonde dispenser design that cuts weight 40%, space 16%, improved and simplified operating system.

AIRCRAFT EQUIPMENT DIVISION

**CONSOLIDATED DIESEL ELECTRIC CORPORATION**

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# Nuclear Powerplant for Moon Outlined

By Edward H. Kolcum

**Washington**—Concept for a compact 1-megawatt nuclear powerplant for operation on the moon, weighing less than 8 tons, has been outlined by the University of Chicago Argonne National Laboratory for the Atomic Energy Commission.

Using mercury as coolant, the plant is powered by a uranium reactor theoretically able to operate continuously for two years. Unusual feature is use of foldable radiators, 72 ft. long, to remove condensation heat from the mercury cycle.

The Argonne report, produced under an AEC study contract, says the design is based on current technology with a minimum of research and development necessary.

The powerplant is conceived for fabrication and assembly on earth, direct launch as payload of an advanced Saturn or Nova vehicle, and soft landing at a site on the moon where meteor activity is at a minimum.

Optimum landing sites are believed to be Mare Imbrium, Mare Serenitatis or Mare Crisium, all facing the earth during the earth evening.

Machinery and controls would be designed to withstand launch and landing shocks and would be sealed in a cylindrical shell. During launch, the radiators would be folded around the shell. When the plant landed, it would be anchored, with the radiator wings automatically unfolding at 90-deg. angles to each other.

None of the plant components are shielded, in a departure from the requirements of earth nuclear power systems. The report maintains that a light, fully-automated system can be expended after 2 yr. of operation in a trade-off for the cost of transporting a heavy conventional plant. Natural shields would be provided by lunar hills.

A complete powerplant consists of three identical units, any one of which would support a manned expedition. Two of the units would be used in normal operation. The reactor is similar to the EBR-1 Mk. III, for which there is long operating experience, and the generator is a 400-cycle a.c. brushless exciter.

The radiators designed by Argonne are considered the only feasible means of removing the low temperature heat from the rankine cycle. The cycle is direct from the reactor to the mercury-vapor turbine. These radiators also are the heaviest components in the plant, 5,300-11,000 lb. depending on materials, and they reduce the power-to-weight ratio in comparison with conventional plants.

The radiator is a vertical tube-fin arrangement, built in concentric cylindrical sections of increasing diameter. Curved headers are connected by swivel joints for quick unfolding after landing.

Radiator design is based on known lunar environmental conditions, and the near-vacuum of the moon makes thermal radiation the only known means of rejecting heat from the thermodynamic cycle.

Argonne designed radiators of three different materials—steel, titanium and magnesium (see table)—to arrive at one with a minimum weight and maximum temperature, with the characteristic of low temperature still required for cycle efficiency. Coolant loss protection is provided by segmenting the radiators into 24 independent sections.

The independent sections also would protect the entire system from failure in case the radiators were punctured by meteors. Cutoff valves at inlet and outlet headers would be used to bypass the damaged section.

The lunar powerplant reactor design, with boiling mercury as coolant, contains 1,082 lb. of critical mass consisting of uranium carbide and enriched uranium. Mercury is the only liquid metal used successfully over long operating periods in the direct thermodynamic cycle. All surfaces in contact with the coolant would be made of a steel alloy containing 5% chromium and 0.5% molybdenum. Corrosion and deterioration have not been observed using this alloy with mercury. Titanium would be added to mercury to further reduce the possibility of corrosion.

The reactor core contains 1,381 fuel rods, bolted rather than jacketed in order to conserve weight. Tendency of the rods to bend or buckle is offset by three radial spacers in each rod structure.

The reactor would be made critical either on a pre-programed sequence or from the remote control center. Mercury flows up through the core into a separator where 10% goes to the turbine in vapor form. Four dividers around the annular frame act as return channels to the recirculating pump for the liquid mercury.

Argonne feels the only maintenance

### Argonne Nuclear Powerplant Weight

| | Steel reactor and radiator | Steel reactor, titanium radiator | Steel and titanium reactor, magnesium-clad radiator |
|---|---|---|---|
| **Reactor** | | | |
| Pressure vessel, ducts, grids, plates, misc. hardware | 2,337 lb. | 2,337 lb. | 2,024 lb. |
| Core | 1,510 | 1,510 | 1,510 |
| Reflector controls, operating mechanisms | 1,403 | 1,403 | 1,262 |
| Turbines and pumps | 700 | 700 | 700 |
| Generator | 999 | 999 | 900 |
| Compressor | 59 | 59 | 53 |
| Reactor total | 7,008 | 7,008 | 6,459 |
| Base and radiator shield (magnesium in all designs) | 293 | 293 | 293 |
| **Radiator** | | | |
| Tubes | 7,592 | 4,244 | 2,314 |
| Manifolds | 1,775 | 992 | 992 |
| Misc. hardware | 945 | 945 | 945 |
| Valves, hoses | 1,049 | 1,049 | 1,049 |
| Radiator total | 11,361 | 7,230 | 5,300 |
| Mercury inventory | 2,893 | 2,893 | 2,893 |
| Total | 21,555 | 17,424 | 14,945 |

required of the plant would be repair of meteor punctures in the radiators and addition of wetting agents to the mercury coolant. Wetting agents would be magnesium or calcium, rather than alkalis, such as sodium, which tend to form undesirable compounds which could cause plugging of circulating system.

The mercury vapor turbine, weighing 550 lb., would have a power of 1,100 kw. and operate at a speed of 6,000 rpm. In the Argonne concept, it is a two-pressure stage impulse-type, but single-stage impulse and velocity-stage machines also can be considered.

The a.c. brushless generator operates at a continuous rating of 1,000 kva., and Argonne says this generator type, with lower rating, is extensively used in aircraft.

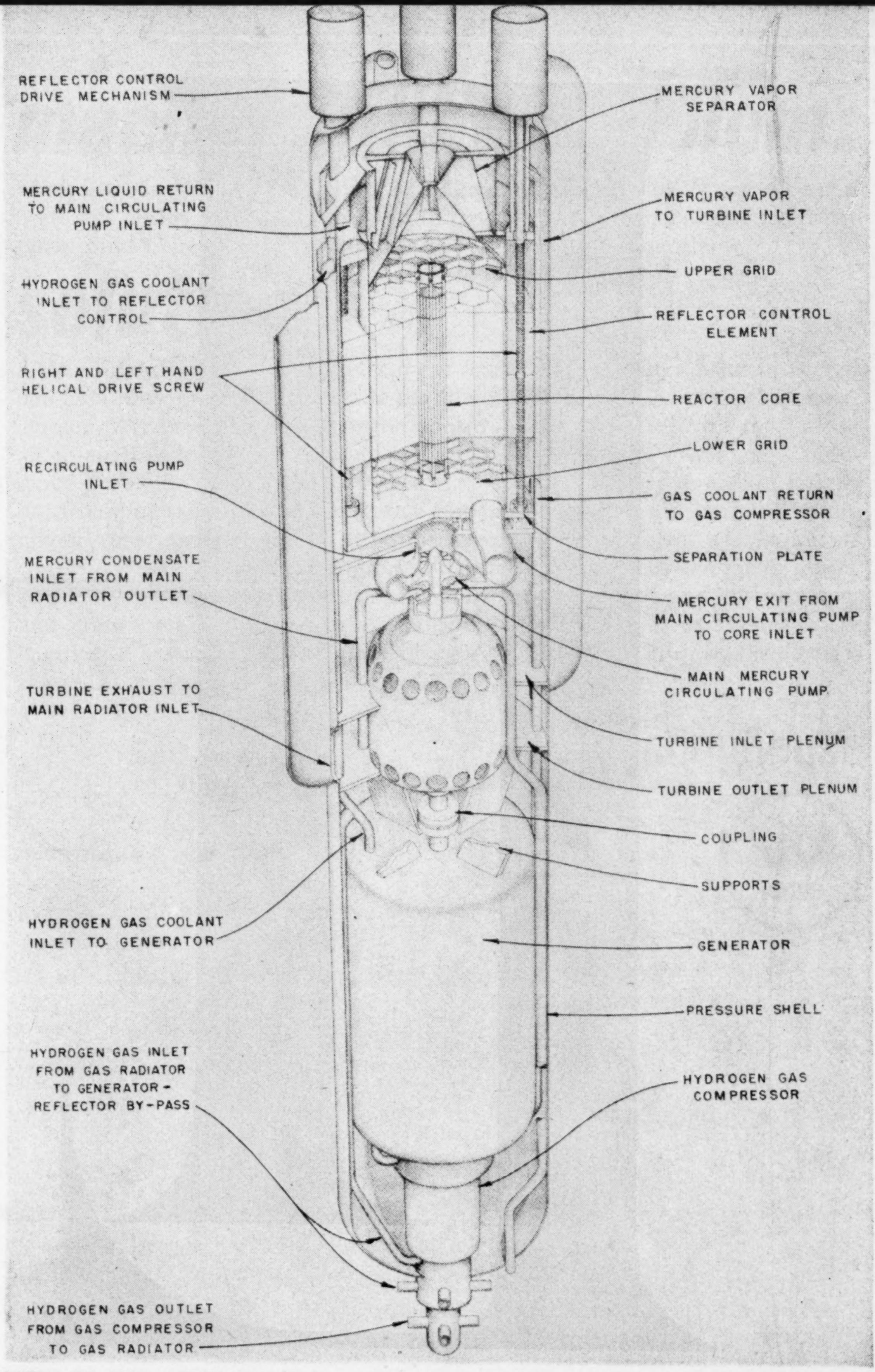
One radial and two mixed-flow pumps would be used for the mercury recirculating and condensing cycles. Radial flow impeller is used in the condensation pump because of the large pressure ratio and the small volume of mercury pumped, and an integral impeller with separate inlets and a common volute is used on the two circulating pumps.

## Hydrogen Cooling System

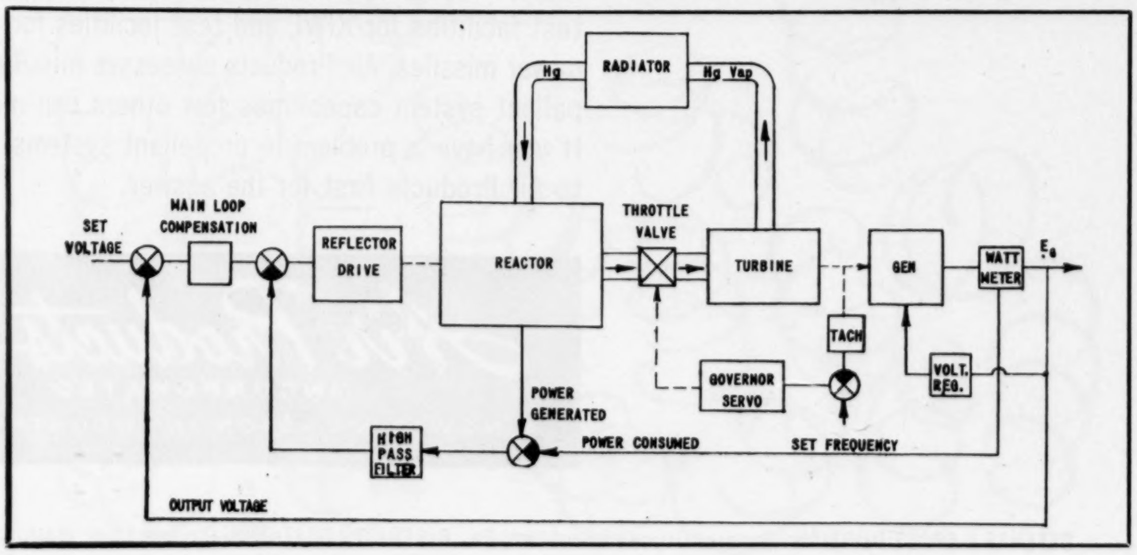
Hydrogen would be used to cool the main generator because it transfers heat by convection. Cooling system in the hydrogen cycle consists of an axial flow six-stage compressor on the main turbine shaft, and a radiator designed to cool machinery from 150F to 50F.

Control system instrumentation for the lunar powerplant has not been designed, and Argonne has isolated these critical instrument requirements:

- **Ionization chambers,** capable of operating at high temperatures with lifetimes of 17,472 hr.—two years. Present chambers have been operated at 1,300F for about 1,000 hr. at moderate radiation levels.
- **Feedthrough seals** able to operate under the combined effects of high temperature and radiation. Particularly needed is data on annealing effects of radiation, and the additive temperature-radiation effects on seals.
- **Structural components** for ionization chambers, since the long-term effect of high temperature on uranium diffusion is not known. If uranium will adhere to titanium, it is probable that titanium would be used for chamber structures.
- **Welds able to sustain** high temperatures under the 15-lb. pressure differential to which they will be exposed on the moon.
- **Cables capable of operating** for long periods under combined high temperature and radiation loads.
- **Electronic instruments** with a wide dynamic current range. Two major


REFLECTOR CONTROL DRIVE MECHANISM
MERCURY VAPOR SEPARATOR
MERCURY LIQUID RETURN TO MAIN CIRCULATING PUMP INLET
MERCURY VAPOR TO TURBINE INLET
HYDROGEN GAS COOLANT INLET TO REFLECTOR CONTROL
UPPER GRID
REFLECTOR CONTROL ELEMENT
RIGHT AND LEFT HAND HELICAL DRIVE SCREW
REACTOR CORE
LOWER GRID
RECIRCULATING PUMP INLET
GAS COOLANT RETURN TO GAS COMPRESSOR
SEPARATION PLATE
MERCURY CONDENSATE INLET FROM MAIN RADIATOR OUTLET
MERCURY EXIT FROM MAIN CIRCULATING PUMP TO CORE INLET
MAIN MERCURY CIRCULATING PUMP
TURBINE EXHAUST TO MAIN RADIATOR INLET
TURBINE INLET PLENUM
TURBINE OUTLET PLENUM
COUPLING
SUPPORTS
HYDROGEN GAS COOLANT INLET TO GENERATOR
GENERATOR
PRESSURE SHELL
HYDROGEN GAS INLET FROM GAS RADIATOR TO GENERATOR-REFLECTOR BY-PASS
HYDROGEN GAS COMPRESSOR
HYDROGEN GAS OUTLET FROM GAS COMPRESSOR TO GAS RADIATOR

**VIEW OF THE ARGONNE** National Laboratory nuclear lunar powerplant (above) shows arrangement of components in cylindrical shell. Plant would be able to generate one megawatt of power over a two-year operating lifetime. Diagram of the plant's control loop (below) shows that the reactor is designed to operate at a steady state under automatic control for extended periods. Primary control is based on system output voltage.


RADIATOR
Hg
Hg Vap
SET VOLTAGE
MAIN LOOP COMPENSATION
REFLECTOR DRIVE
REACTOR
THROTTLE VALVE
TURBINE
GEN
WATT METER
$E_o$
TACH
GOVERNOR SERVO
VOLT. REG.
POWER GENERATED
POWER CONSUMED
SET FREQUENCY
HIGH PASS FILTER
OUTPUT VOLTAGE

$LH_2$

Air Products pioneered in the application as well as the production of liquid hydrogen . . . the ultimate fuel . . . for missiles and rockets. Examples: the test facilities for KIWI, and test facilities for even newer missiles. Air Products possesses missile propellant system capabilities few others can match. If you have a problem in propellant systems, look to Air Products first for the answer.

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**DEFENSE & SPACE DIVISION:** General Office: Allentown, Pa. **DISTRICT LOCATIONS:** Dayton, Ohio; Washington, D. C.; Los Angeles, Calif.; Winter Park, Florida.

channels required are the level indicator and the period indicator, both of which must be small, reliable and able to operate with low power requirements.

- **Detector locations,** to determine the radiation level without influences of flux, temperature, motion of control rods and nearby materials.

Radar and visual observations indicate the frequency of meteors to be about four times greater at dawn than in the evening, and for this reason a site always facing the earth would protect the powerplant from maximum meteor exposure, Argonne said. In addition, there probably will be a requirement for television communications from the station, which also requires a powerplant site on the near side of the moon.

Argonne believes that a nuclear plant will be required to provide electrical power for any extended lunar expedition, such as military operations, weather forecasting stations, television relays, stellar observatories, physical observatories and spacecraft refueling stations.

Development of high power, high density fast reactors for space use will result in "ultracompact" plants adaptable to marine, military or other mobile use on the earth, according to the Argonne report. The current concept is based on mercury as coolant because of its long use, but advanced concepts should be developed, Argonne said. Among them are high temperature gas, liquid metals other than mercury, high temperature fuels, structural materials, turbomachinery and instrumentation.

The lunar powerplant design is detailed in report ANL-6265 available through the Department of Commerce Office of Technical Services. Authors are R. H. Armstrong, J. C. Carter, H. H. Hummel, M. J. Janicke and J. F. Marchaterre.

## Spacecraft 'Bumpers' Studied by Convair

General Dynamics' San Diego Convair Division has begun a research program to establish design concepts for "bumpers" to protect space vehicles in collisions with meteoroids, under a $54,000 National Aeronautics and Space Administration contract. The one-year study is an extension of work already done by Convair in this field.

Impact velocities up to 20,000 fps. will be simulated by firing tiny steel pellets at copper, aluminum alloys, magnesium alloys, titanium and laminated and composite structures.

Techniques under development are expected to produce velocities up to 150,000 fps.

**machinability problem:**

Minimize complicated machining of inner-magnet phase for a control system hysteresis clutch. Meet close casting tolerances without machining from bar stock. Find materials method that cuts costs most significantly.

**solution:**

A Westinghouse precision investment casting eliminated a complicated machinability problem for missile manufacturer Hughes Aircraft Company, Tucson, Arizona. Hughes is prime contractor to the USAF on the Falcon air-to-air missile. Materials competence at Westinghouse solves many aerospace problems. For example: Nivco high damping alloys minimize fatigue in turbine metallurgy . . . thin gauge Hiperco magnetic alloy strip simplifies missile generator design . . . Hipernik special alloy performs well in missile control systems and torque motors. For data on magnets, magnetic alloys, refractory metals, non-fuel nuclear materials, investment and shell castings and conversion of your special material, contact the Westinghouse sales engineer. Or write, Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pennsylvania. *You can be sure . . . if it's Westinghouse.*

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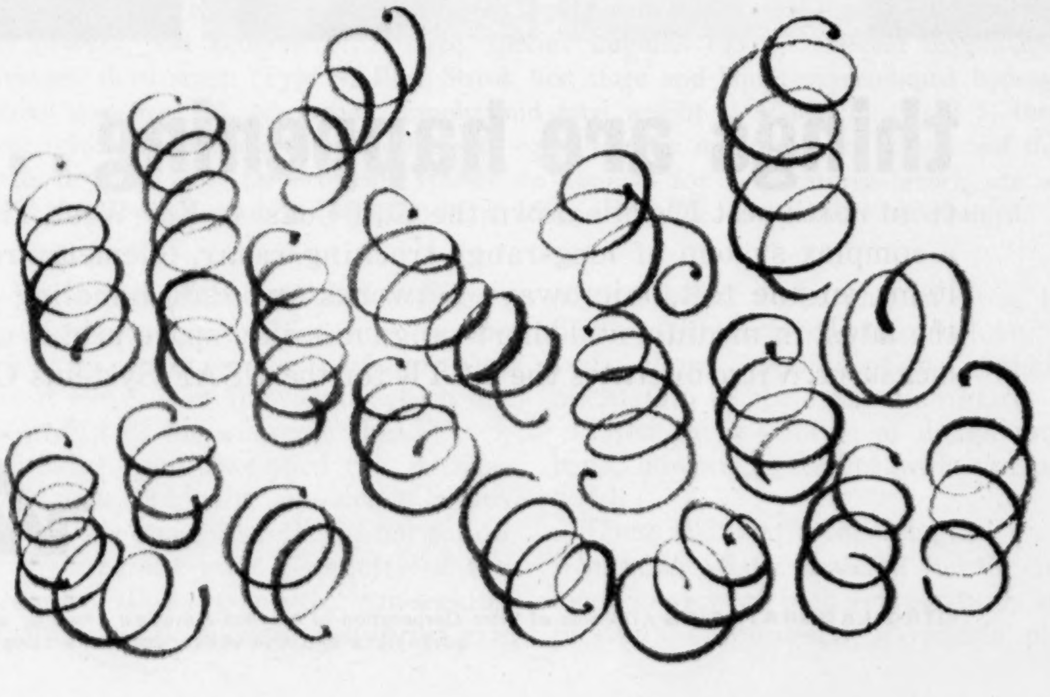
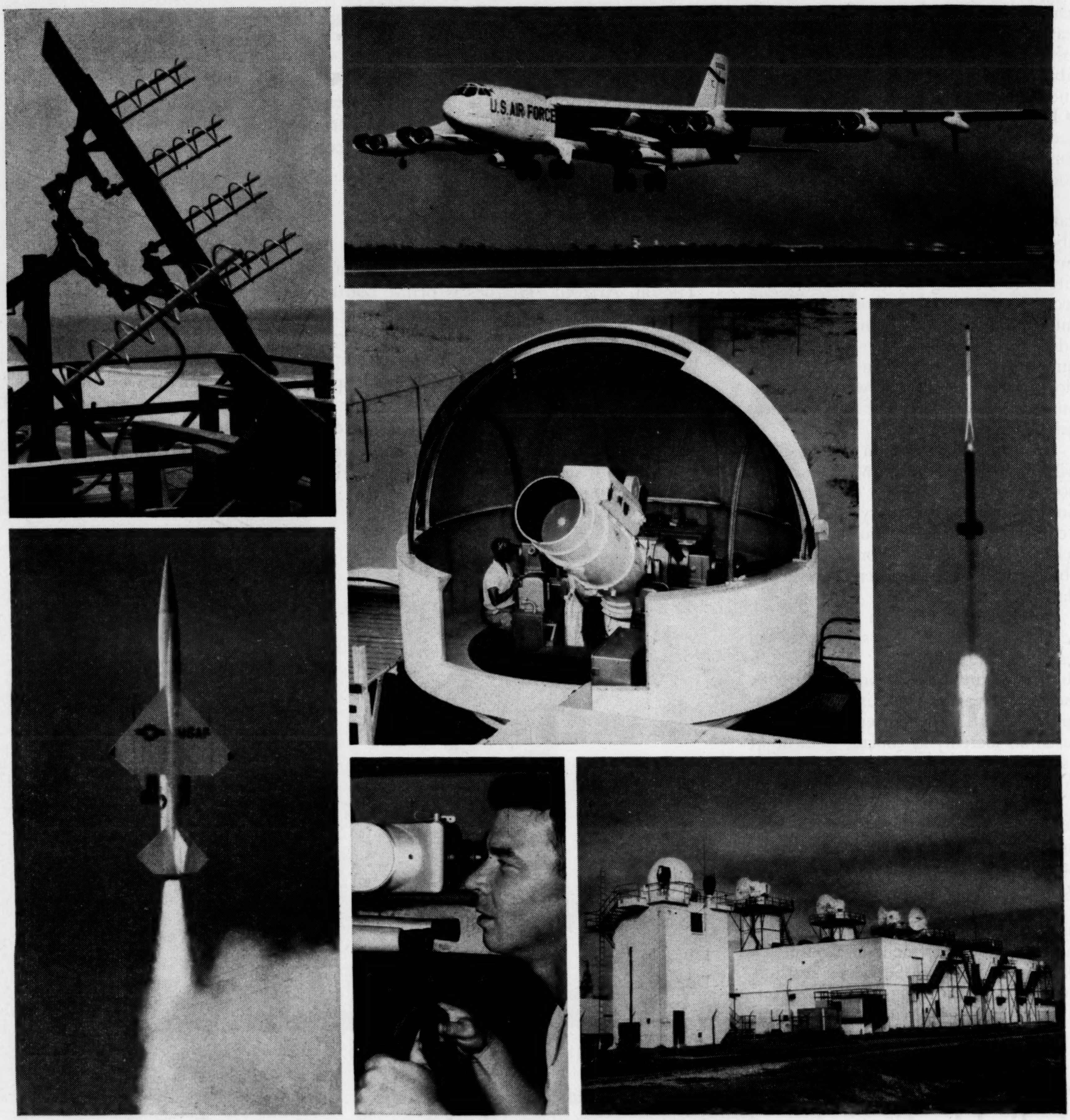
**Westinghouse**





**things are happening . . .**

from northwest Florida down the Gulf Coast to Key West. This is the Eglin Gulf Test Range: a complex system of long-range tracking radar, telemetry receivers able to record over 200 items on one test, microwave networks and data-handling equipment. Its mission: testing the latest in medium and short-range missiles, space probes and advanced electronic countermeasures. Vitro operates the EGTR for the USAF Systems Command.

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SCIENTISTS AND ENGINEERS: JOIN THIS TEAM

# British Study Solar Propulsion Systems

By Herbert J. Coleman

**London**—Advanced Projects Group of Hawker Siddeley Aviation has undertaken a series of studies aimed at eventual design of a lightweight solar propulsion unit using hydrogen as a propellant to raise a satellite from a low circular orbit into a geo-stationary orbit.

The unit is designed for a family of launch vehicles based on Blue Streak for a 24-hr. orbit time which would have advantages for television, radio and telex communication links.

Two Group scientists, P. A. E. Stewart and J. F. Swale, told the European Symposium on Space Technology, that U.S. projects involving ion and plasma production, particularly the Snap 8 nuclear reactor system, can put payloads of 18,500 lb. in 24-hr. orbit but added:

"Such satellites are beyond the present payload capability of proposed European launch vehicles and it would also seem wasteful to carry power sources into space where there is an abundance of solar energy."

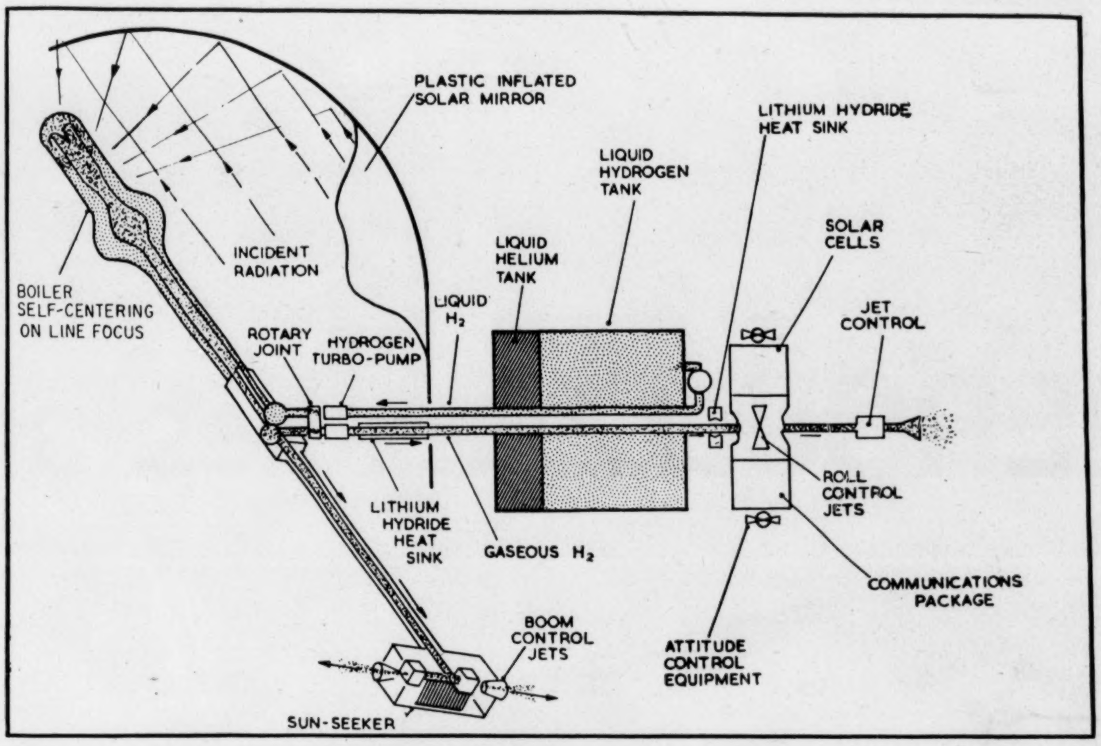
Solar-heated hydrogen unit, envisioned by Hawker Siddeley, would be injected into a low orbit and a transparent plastic balloon then inflated. The balloon is covered with a large number of dots of less than 3 in. diameter and placed so that a hemisphere of the balloon, presented from any angle, has half its surface covered with the dots. Outside and inside of each dot has a high degree of reflectivity.

When the balloon is inflated, a retractable mast is erected inside it; this mast carries a folding boom on trunnions at its tip. The boom, which erects to an integrated section, has at one end a sun-seeking device controlling two reaction jets. At the other end is a solar boiler shaped so that incident radiation from the sun via the spherical reflecting balloon has an even flux over most of its surface area.

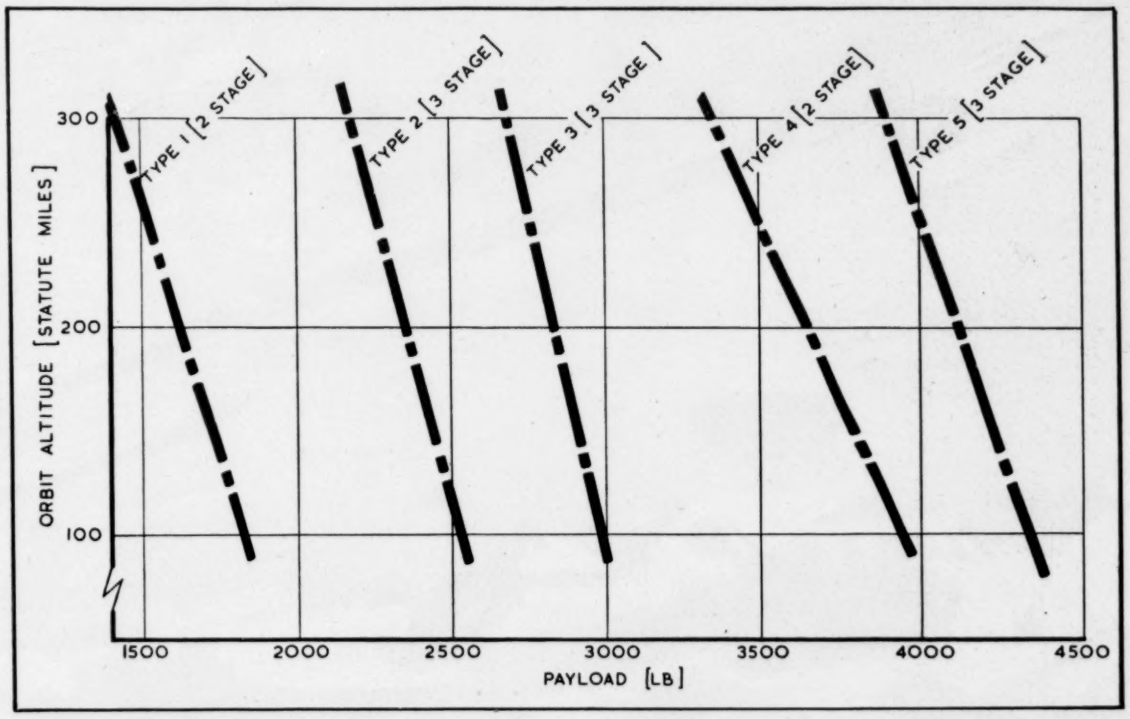
## Two-Cycle Operation

System operates in two cycles:

- **In first cycle,** solar energy impinges on the outside of the balloon. Half the energy is reflected and half passes into the balloon. Of the energy entering the balloon, half is reflected toward a line focus from the reflective dots on the inside, causing an intense flux at the surface of the solar boiler. Remaining half passes out again into space.
- **In the second cycle,** liquid hydrogen is fed by pumps or pressure up the mast and through one of the trunnions to the solar boiler where it is superheated. It then passes back down the boom core to the mast, where division of flow occurs.



**BOOM** of solar power unit shown extended after erection of mast within plastic balloon.



**VARIATIONS** of Blue Streak launch vehicle and their flight regimes, developed by S. R. Dauncey, Hawker Siddeley Advanced Projects Group, are: (Type 1) two-stage, using Blue Streak and Black Knight; (Type 2) same as Type 1 with addition of third stage using high test peroxide and kerosene of 250 sec. specific impulse; (Type 3) liquid oxygen-liquid hydrogen third stage; (Type 4) Blue Streak first stage and liquid oxygen-liquid hydrogen second stage for 420 sec. specific impulse and total weight of 20,000 lb; (Type 5) three-stage vehicle for 300 mi. circular orbit with equal velocity increments for second and third stages of 7,000 fps. Dauncey said studies are assumed for an equatorial launch site and notes that payload capability of 4,250 lb. at 150 mi. altitude may possibly be obtained.

Major part of superheated hydrogen passes through a transfer tube to the expansion nozzle; minor part moves to jets at the end of the boom, which are controlled by the sun-seeker head.

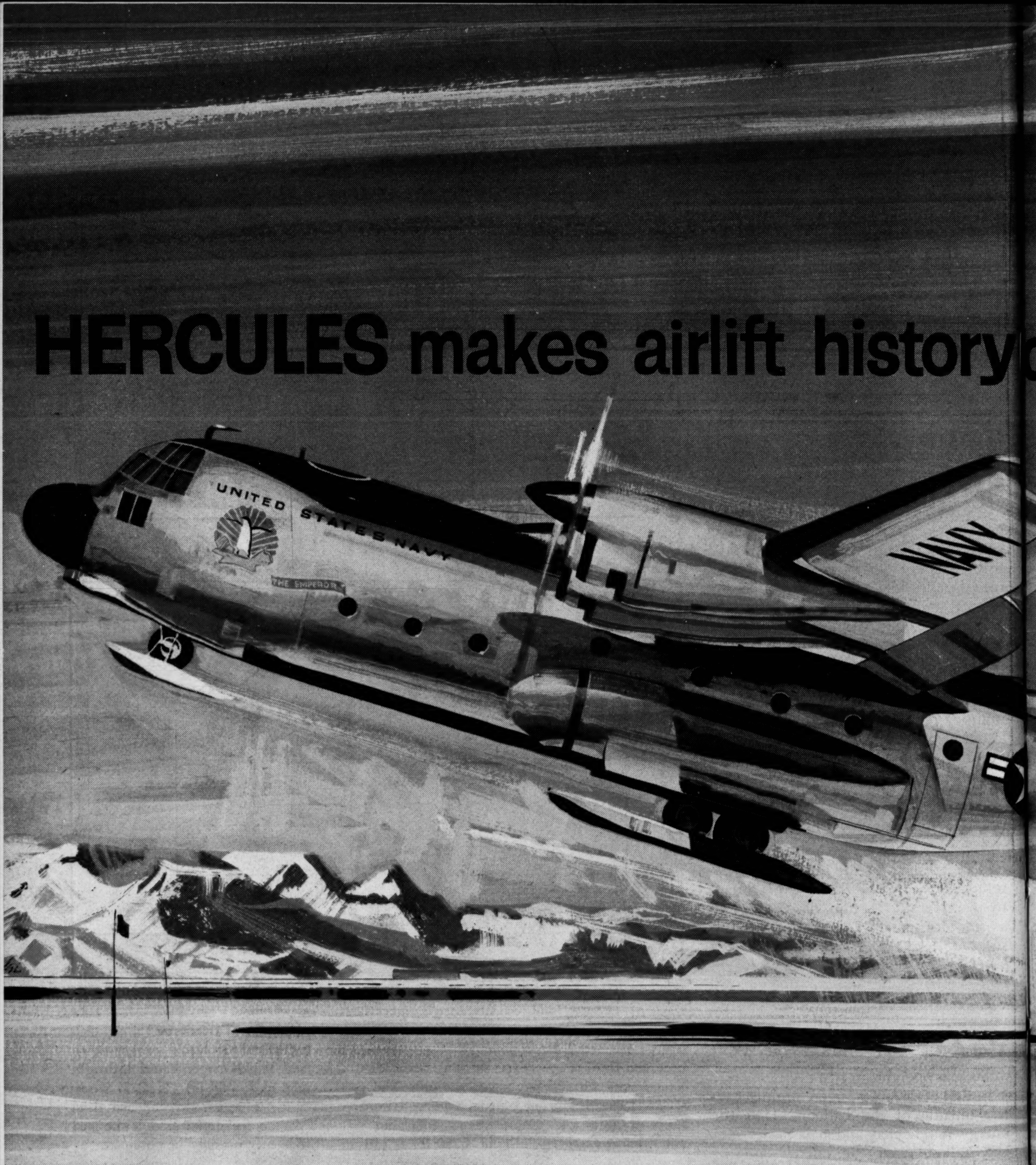
Stewart, who developed this particular system, said the sun-seeker moves toward the sun under the initial action of the auxiliary jets. Geometry of the assembly allows complete sun-seeking capability while allowing the thrust axis of the vehicle to be aligned along the flight path. Half-reflective balloon, he said, allows omnidirectional, passive orientation of the reflective surface.

There are a number of design problems, however, inherent with the proposal.

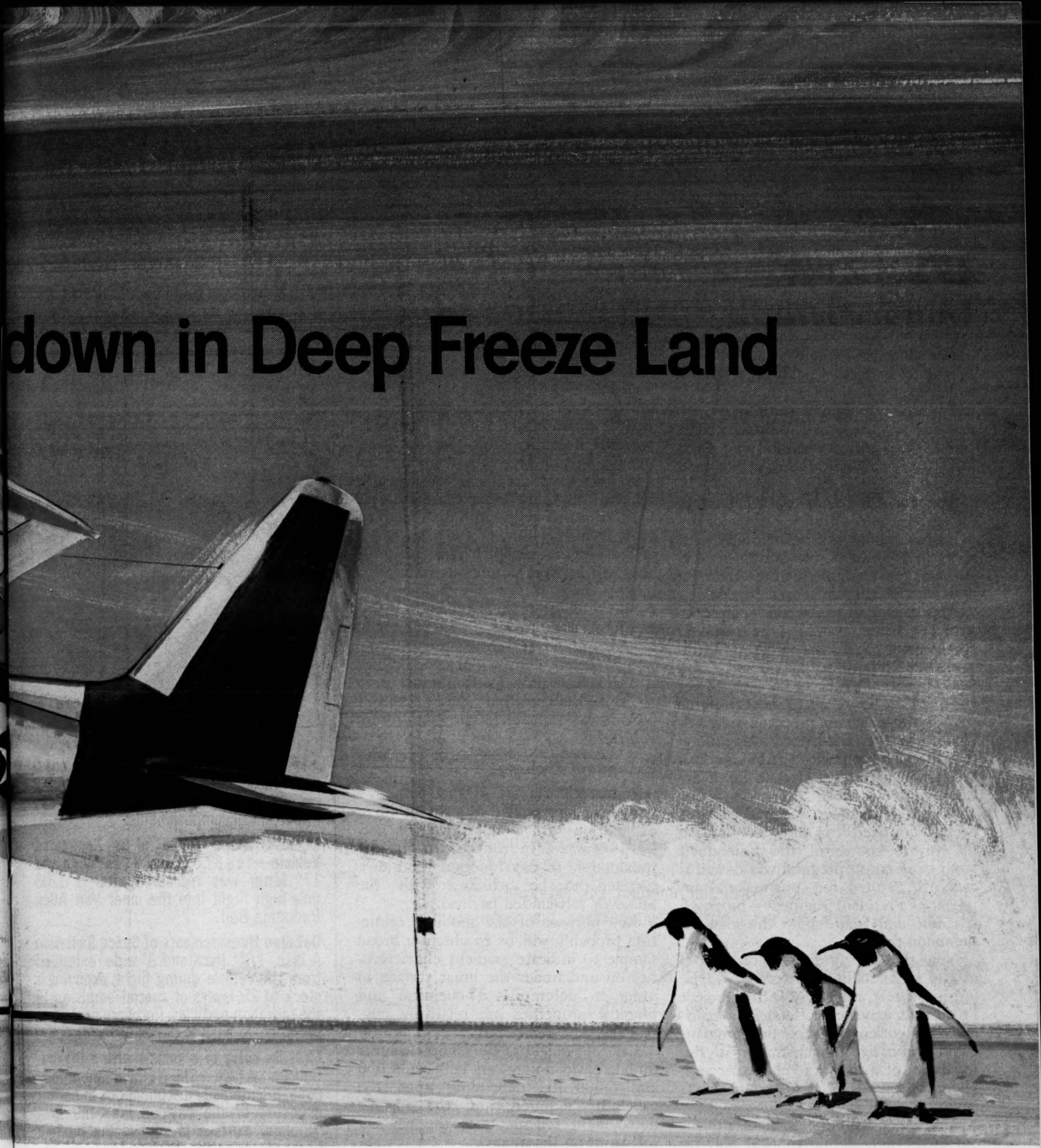
These include the following:

- **Suitable plastic material** for the balloon, in view of high temperatures and pressures encountered. Available plas-

# HERCULES makes airlift history



During Operation Deep Freeze 1960, Hercules Ski-130s flown by the Air Force became the largest airplanes and first turbine-powered craft to touch down at the South Pole. Now the Navy has its own Lockheed Ski-130s to support America's scientific expedition on Antarctica. The Navy and its big propjet ski birds—


down in Deep Freeze Land

assigned to VX-6 squadron—set new South Pole airlift records every day, opening the frozen continent to complete exploration. Lockheed Aircraft Corporation, Georgia Division, Marietta, Ga.

**LOCKHEED GEORGIA**

tic is Mylar, used in the Echo satellite, of which the British equivalent is Terylene. Inflation can be accomplished by hydrogen or helium gas from a bottle, or from a vent in the unit's storage tank. Mast can be erected by a one-shot pneumatic or cartridge-operated snap jack.

- **Trunnions supporting the boom** require development work to produce rotary seals efficient at 15K and 2,500K at pressures reaching 10-15 atmospheres.
- **Reduction of solar heat** transferred to the tank; one method is to make the hydrogen tank surface highly reflective. Another is to insulate tank walls with powdered or sheet plastic, such as Fiberglas or styrofoam.
- **Thrust vectoring,** in which the simplest technique appears to be development of a plug or bullet which would move within an inverted nozzle.

# JPL Considers Vehicle to Return Lunar Sample to Earth for Study

**Los Angeles**—Sample of surface and subsurface material weighing one pound, collected by a mobile vehicle on the moon and returned to earth in an unmanned pre-programed re-entry vehicle, could reveal critical chemical and physical data to facilitate follow-up manned landing experiments.

Analysis of the sample in a laboratory on earth would afford a degree of detail which could not be obtained with a limited amount of equipment examining crust samples at the lunar site and telemetering data back to earth.

Approaches to realize this sample return are being examined by National Aeronautics and Space Administration's Jet Propulsion Laboratory in connection with Project Prospector. Study contracts are expected to be issued this year if the program proceeds as a follow-on to the soft-landed non-mobile Project Surveyor payload (AW Jan. 30, p. 25) which Hughes Aircraft Co. is developing for NASA.

Project Prospector concept has not been definitized for industry because the future course of the unmanned lunar exploration program was doubtful as NASA waited for congressional approval of President Kennedy's proposed schedule and funding for the man-on-the-moon program.

Now that the President's reappraisal of the manned lunar program will be put into effect, it is possible that Project Prospector may be accelerated or reoriented. Reorientation of the program could emphasize demonstration of the feasibility of a logistics vehicle for supplying astronauts or bases in the lunar environment.

Another possibility is that Project Surveyor's non-mobile concept may be expanded to include a mobile lunar surface sampling payload with capability for rocket return to earth. Under this approach, a launch vehicle other than the Atlas/Centaur probably would have to be employed to accommodate the substantially added weight that a mobile vehicle and its return-rocket would entail.

But even though specific requirements for Prospector's sample-collecting mobile vehicle and its sample-return rocket have not been formulated and issued by NASA's Jet Propulsion Laboratory, industry members intending to submit proposals in the expected competition are anticipating that the lunar mobile mission originally contemplated will hold, and are projecting feasible schemes to bring lunar crust material back to earth with an unmanned re-entry vehicle.

Prospector's mobility concept probably will be to explore a relatively small area—perhaps a few hundred yards—from the point of lunar touchdown, because extensive roving of the vehicle in a new and hostile environment would not be practical in initial experiments.

The vehicle probably would just creep to shift its position during sample pickup and transfer to the earth-return vehicle.

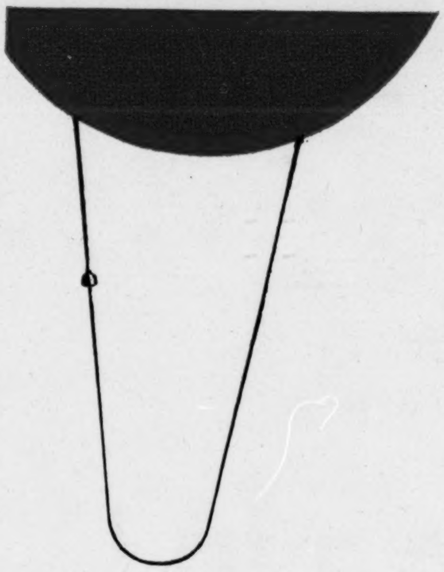
## Extended Probing

Industry estimates are that perhaps a period as long as six months of lunar exploration with a mobile vehicle may be programed, in contrast to the approximately 60-day function limit now targeted to be achieved with the Surveyor soft-landed payload.

Key purpose of the mobile exploration probably will be to obtain a broad sample to indicate gradient characteristics on and under the lunar surface in order to determine if chemical and physical properties are relatively consistent.

Landing weight of the complete lunar mobile payload may vary between 4,000 and 6,000 lb., depending upon the capability required, and the specific deployment scheme once the payload soft-lands on the moon.

The soft-landed payload might itself be the mobile vehicle or the mobile vehicle may be another unit which separates from the main payload which would be stationary and used for other lunar experiments, with results telemetered to earth. One experiment projected for Prospector involves seismic recordings, following explosive charges set off to probe characteristics of lunar subsurface structure. An advanced lunar



**NERV**

From the first Nuclear Emulsion Recovery Vehicle (NERV) launch and recovery on September 19, 1960, came these important accomplishments:

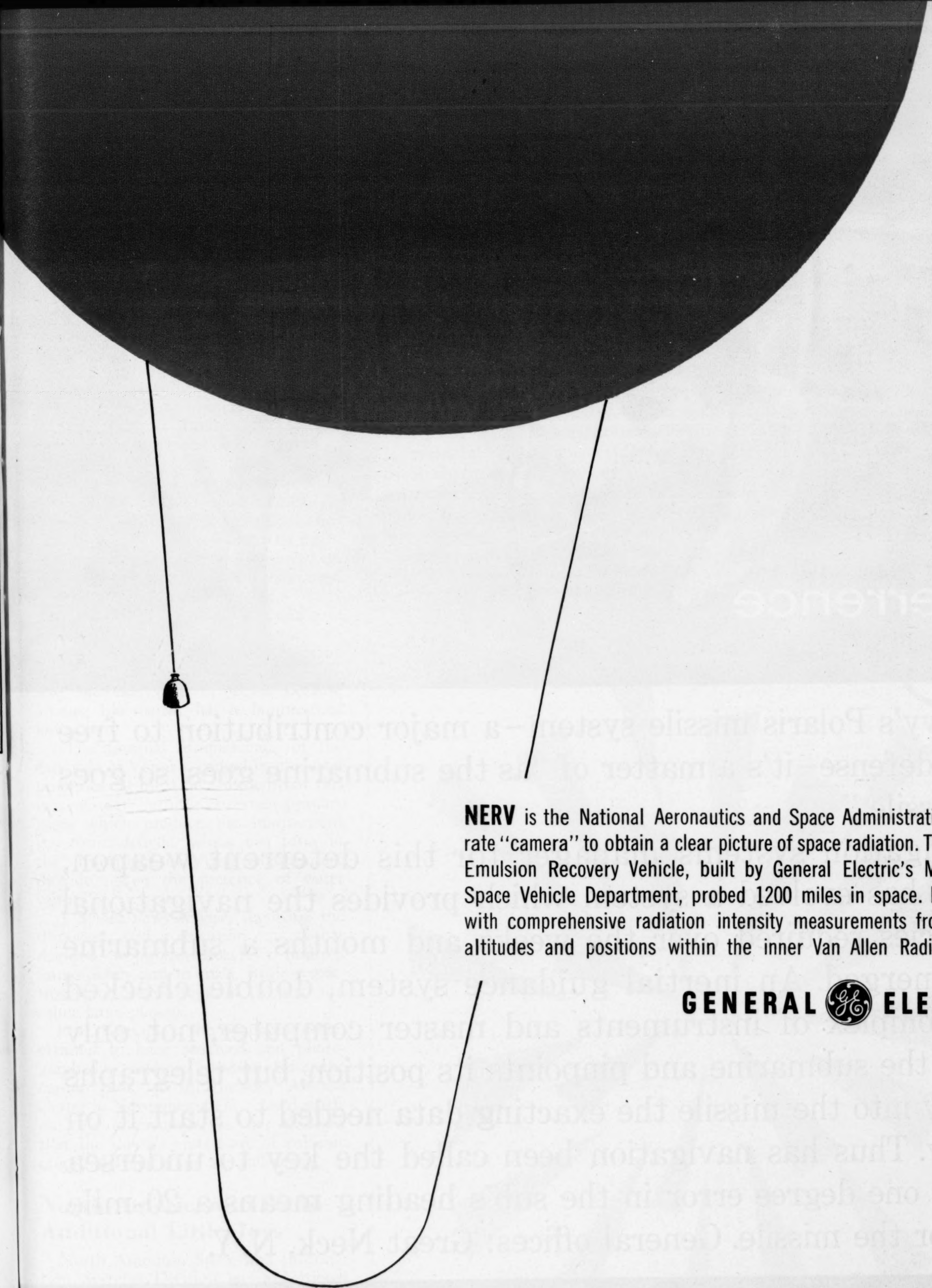
**Highest Space Probe of a Recovered Vehicle**—The 83.6 lb NERV (19" wide and 17" long) was recovered after a 1200 mile-high flight into the inner Van Allen Radiation Belt.

**Detailed Measurements of Space Radiation** A disc, 1/2" thick and 3" wide, extended from the vehicle during flight, exposing a stack of 25 layers of special emulsion to the radiation particles. Recovery permitted scientists to analyze the emulsion directly.

**First Re-entry of a Vehicle with a Discontinuous Surface**—The NERV ablation nose cone, intentionally discontinuous to permit exposure of the payload, was the first "broken" surface to survive the intense heat of re-entry. Performance of the vehicle was successful in all respects.

General Electric's Missile and Space Vehicle Department designed and built NERV for National Aeronautics and Space Administration's Goddard Space Flight Center. MSVD is a department of the G.E. Defense Electronics Division. 160-04

**GENERAL ELECTRIC**



**NERV** is the National Aeronautics and Space Administration's accurate "camera" to obtain a clear picture of space radiation. The Nuclear Emulsion Recovery Vehicle, built by General Electric's Missile and Space Vehicle Department, probed 1200 miles in space. It returned with comprehensive radiation intensity measurements from various altitudes and positions within the inner Van Allen Radiation Belt.

**GENERAL ELECTRIC**

MISSILE AND SPACE VEHICLE DEPARTMENT, PHILADELPHIA, PA.

deterrence

In Navy's Polaris missile system—a major contribution to free world defense—it's a matter of "as the submarine goes, so goes the missile."

Navigation systems manager for this deterrent weapon, Sperry has evolved a system which provides the navigational accuracies required over the weeks and months a submarine is submerged. An inertial guidance system, double checked by a complex of instruments and master computer, not only guides the submarine and pinpoints its position, but telegraphs directly into the missile the exacting data needed to start it on its way. Thus has navigation been called the key to undersea firings: one degree error in the sub's heading means a 20-mile miss for the missile. General offices: Great Neck, N. Y.

Other Sperry contributions to deterrent weapons: precision acquisition, tracking and guidance radars for Navy's Terrier and Talos missiles; bomb-nav system for USAF's B-58; Army's Sergeant missile system; Sperry's Polaris submarine navigation simulator (main illustration).

SPERRY

seismograph system being developed by Columbia University may be used for this shock detection.

Firing of the return rocket containing the sample would be pre-programed along a lunar-earth trajectory for landing in a predetermined area, to ensure retrieval of the lunar sample.

## Soviet Scientist Claims New Venus Findings

**Washington** — Soviet astronomer Nikolai A. Kozyrev claims to have proved that the planet Venus has a luminescent ionosphere and to have discovered "a fact hitherto unknown to science—a constant luminescence of the lower strata of its atmosphere which occurs within the clouds of that planet or lower down."

At the time of a new moon, the darkened portion of the moon's face can be seen faintly because of a luminescence caused by light reflected from the earth. A luminescence sometimes observed on the darkened face of Venus had been dismissed as an optical illusion.

But Prof. Kozyrev told Leningrad scientists at Pulkovo Observatory recently: "I have succeeded in proving that this phenomenon is a fact, and also the fact that it occurs because Venus, like earth, has a luminescent ionosphere. . . .

"The unusual luminescence of the dark side of Venus is caused by chemical processes. It must be assumed that this is a retarded burning of certain primary gases which produce the luminescent gas formaldehyde, which can form in the atmosphere of Venus from carbon dioxide, given the presence of water vapor."

A Soviet news service, reporting the discovery, said a scientific council has decided to publish Kozyrev's findings immediately and to make further spectroscopic observations of Venus and other large planets.

Prof. Kozyrev is the astronomer who claimed to have observed and photographed a gaseous emission from the center peak of the moon's Alfonso Crater in November, 1958. Based partly on this observation, he has declared that the moon's craters are of volcanic origin and that some are still active.

## North American to Build Additional Little Joes

North American Space and Information Systems Division has a National Aeronautics and Space Administration contract to supply another two Little Joe boosters, bringing the total to nine. First seven were used in Mercury capsule tests. Eighth is to be delivered in October, and the ninth six weeks later.

**noise problem:**

Silence the switching action of a 7½-hp refrigeration compressor motor starter aboard the submarine U.S.S. *Ethan Allen.* Design a small, lightweight motor starter that's noiseless, operationally infallible, unaffected by shock, vibration and corrosion.

**solution:**

Westinghouse designed and built a static motor controller for Electric Boat Division, General Dynamics Corporation, Groton, Conn. Completely silent. No moving parts. Oscillograms at impact show no evidence of distortion or interruption of the a-c power to the motor. Unit is quickly and easily interchangeable with its conventional electromechanical counterpart. Response: ½ cycle, faster than any controller available today. Retains original electrical characteristics without attention, even after 3¼ million operations. All parts hermetically sealed or encapsulated. To meet your specific electronic requirements, contact your Westinghouse sales engineer. Or write: Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pa.

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J-92515

**Westinghouse**

# Thin Film Solar Cell Research Advances

By Barry Miller

**Los Angeles**—Second generation of solar cells which could drastically reduce the cost and weight of solar panels for space vehicles and add a degree of flexibility to the design of energy conversion systems not now possible with conventional cells may be available for at least limited applications in spacecraft within the next two or three years.

This estimate of the availability of a new type of solar cell is made by a number of scientists at laboratories engaged in studies or research on thin film solar cells—solar cells made by one of several techniques of depositing films or layers of semiconductor materials on suitable substrates.

A smaller group of researchers questioned recently by AVIATION WEEK is, however, far less optimistic about the status of thin film solar cell progress.

These researchers' views perhaps are summarized by scientists at the Army's Signal Research and Development Laboratory, who have conducted in-house research on thin film cells and sponsored —and contemplate additional support for— similar programs in industry. They say it would be overly speculative to predict at this time results that they regard as depending largely on unpredictable future technological developments.

## Ultimate Advantages

There does appear to be consensus though among many working in the field about the ultimate advantages of solar cells derived from current research programs on thin film solar cells. These advantages would include:

- **Low Cost**—Various film deposition processes by which thin film solar cells are fabricated can be adapted to continuous processing which should drive costs down. Also, in thin film cell processing there wouldn't be wastage of expensive semiconductor material as there is in conventional solar cell processing. (Conventional solar cells are made by slicing single crystal boules into slabs, then diffusing junctions into the slab. Material is wasted in the several processing steps; in addition, a good part of the cell thickness is unnecessary to the photovoltaic process).
- **Higher Power Density (power/lb.)**—Thin film solar cells are expected to provide more power for given amounts of weight than conventional cells. Dr. James Elliott of General Electric Co. estimates (AW Oct. 17, p. 63) that film devices could provide 0.8 lb./kw. ratios (polycrystalline silicon not including necessary structural material) as opposed to the much higher 15 lb./kw. figure for conventional silicon solar cells. Supporting structure for solar cell films could boost the favorable ratios, but the structure might be an integral part of a space vehicle.
- **Contouring**—Solar converter systems preshaped to desired contours of a space vehicle might be possible with films.
- **Reliability**—Better reliability might be expected from solar cell films because large area solar cell films (perhaps a foot square or greater) could be deposited, thereby minimizing interconnections among cells. Dimensions of conventional cells are about 1 by 2 cm.
- **Radiation Resistance**—Thin film devices may be more capable of resisting irradiation by high energy charged particles.

If thin film solar cells do emerge from research laboratories as useful energy converters for space vehicles they will do so with far less fanfare than has accompanied many other new avionic developments. The failure of some companies—including several manufacturers of solar cells—to initiate or continue previous research on thin film solar cells is evidence of the division of opinion within the industry over the immediate prospects for these large-area solar cells.

Nevertheless, several companies report significant progress with thin film solar cell research. Merck & Co. indicates it has supplied samples of single crystal, epitaxially grown silicon solar cells to government agencies and commercial firms. These have efficiencies comparable to those of conventional solar cells and are made as thin as four or five mils (conventional cells are roughly 20 mils thick). Harshaw Chemical Co. has vacuum-evaporated polycrystalline cadmium sulfide cells with efficiencies up to 3.5%. Although the latter figure is dwarfed by the 10 to 14% figures quoted for conventional commercial cells, the anticipated high watts-per-lb. ratios will exceed those of higher efficiency single crystal solar cells, Harshaw says.

The minimum thickness of conventional solar cells is not governed by the photovoltaic effect which occurs within roughly ¼ of the cell's depth, but rather by the inability of existing technology to permit handling and processing of thinner slices. Consequently, there is an excess weight and volume with each cell. In addition, the over-all size of the cell cannot be any larger than the grown crystal from which slices are cut. To obtain desired larger area cells and to achieve weight reductions and materials savings, thin films, primarily polycrystalline, have been under study for some time.

Polycrystals have an advantage over single crystals in that they can be deposited on foreign substrates, glass, quartz, etc., without regard to the crystal structure of the supporting material. This permits deposition of films as large in area as the depositing technique will allow.

Balancing this important advantage is a discouraging shortcoming. Efficiencies of polycrystalline film cells generally do not exceed half those of conventional cells. Because there is an appreciable materials saving, giving a higher power per unit of weight, there is a point at which the higher efficiency of conventional cells is offset by the weight economy of film cells.

The possibility of making thin film solar cells from single crystal semiconductors has been rekindled in the past year by the success of several companies—including Merck and International Business Machines (AW July 4, 1960 p. 82)—with semiconductor growth by epitaxy (crystal of the film so oriented that it matches that of the substrate).

## Another Obstacle

Even with the ability to grow by epitaxy, scientists who were questioned contend that another important obstacle must be hurdled before large area single crystal cells can be realized. This is the need to locate a suitable large area, inexpensive substrate whose crystal structure closely resembles that of the film semiconductor on which the latter can be deposited. If an identical semiconductor, such as silicon, is used as the substrate, then the maximum area of the cell is still curtailed and the amount of silicon employed continues to be large, these scientists say.

Many laboratories, primarily in search of thin film transistors and diodes, currently are investigating foreign substrates whose crystal structures closely resemble those of the depositing semiconductor so that films may be put down successfully on them. Other requirements, such as the need for matching thermal characteristics of substrate and film, also must be satisfied.

One group, Lear's Solid State Phys-

## Thin Film Solar Cells

| ORGANIZATION | APPROACH | MATERIALS | STATUS | EFFICIENCY | COMMENTS |
|---|---|---|---|---|---|
| **CLAUSER TECHNOLOGY CORP.** | Evaporation of multiple layers of polycrystalline semiconductors on foreign substrate (such as glass, quartz). | | Study | | |
| **GENERAL ELECTRIC CO.** | Chemical deposition of polycrystalline materials. | Cadmium telluride, silicon | Research | | Supported by USAF's Aeronautical Systems Division and Army's Signal Corps. |
| **HARSHAW CHEMICAL CO.** | Vacuum evaporation of macrocrystalline films on conducting tin oxide coated glass. | Cadmium sulfide, other group II–VI compounds | Research & development | 3.5% | Even at 3% efficiency expected high watts/lb. of these film cells will exceed those of high efficiency single crystal solar cells. |
| **HELIOTEK CORP.** | | | Study | | Company-sponsored study on thin film solar energy conversion devices expected to grow into full R&D program. |
| **HOFFMAN** | Both chemical decomposition and vacuum evaporation. | Primarily silicon, also gallium arsenide | Research | | Company funded.<br>Polycrystalline silicon solar cells with areas up to 1 sq. ft. and efficiencies from 5 to 8% are expected within 2 years. |
| **LEAR** | Epitaxial growth of single crystal semiconductors on a foreign substrate.<br>Chemical decomposition. | Silicon and others | Study | | Company has successfully deposited single crystal germanium on one foreign substrate and silicon on another by technique which will permit films of considerable area to be deposited. |
| **MERCK & CO.** | Single crystal silicon epitaxially grown on silicon substrate.<br>Pyrolytic decomposition. | Silicon | Research samples supplied to government agencies and commercial firms | Comparable to conventional solar cells | Under company sponsored program, solar cell structures up to 6 in. x ¼ in. made.<br>Cells can be made as thin as 4 or 5 mils. |
| **MINNEAPOLIS-HONEYWELL** | Deposition of polycrystalline silicon on different foreign substrates.<br>Junction is double diffused into film. | Silicon | Research | 1% | Film thickness varies from 1 to 3 mils.<br>Measured open circuit voltage is $0.35^1$; short circuit current is 3 to 4 $ma/cm^2$. |
| **RADIO CORP. OF AMERICA** | Single crystal and polycrystalline deposition. | Cadmium sulfide, silicon and others | | Over 4% | |
| **U. S. ARMY SIGNAL RESEARCH & DEVELOPMENT LABORATORY** | Polycrystalline films deposited on non-silicon substrates. | Silicon | Research | | |

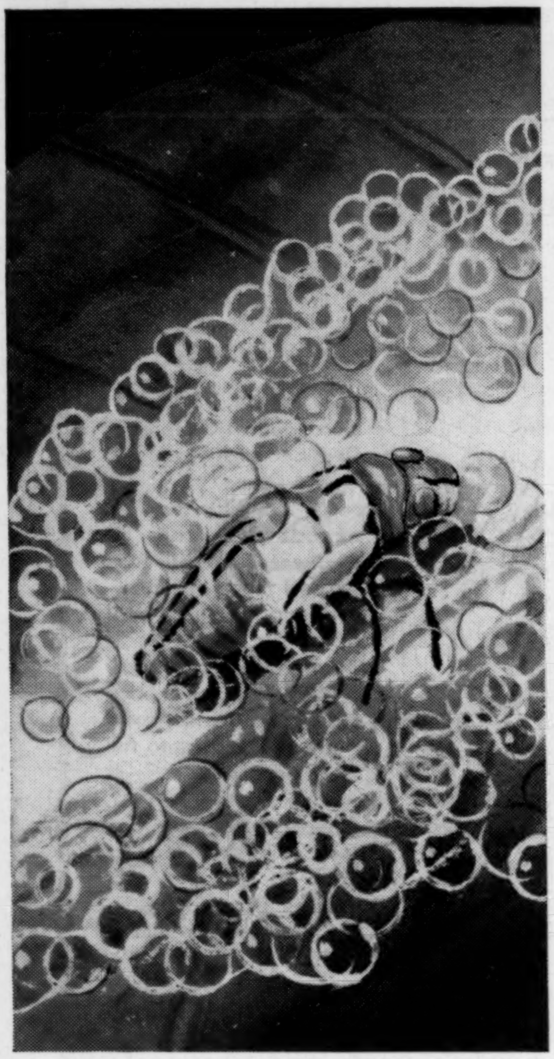
ics Laboratory, has successfully vacuum-evaporated n and p types of single crystal germanium films onto a single crystal foreign substrate (dielectric) which can be grown in appreciable sizes from solution. More recently this laboratory has evaporated silicon on different substrates. Although this work has been performed in connection with its research on thin film active devices, Lear estimates that solar cells, possibly 1 ft. square, could be fabricated by its epitaxial process.

A variety of materials, including silicon, gallium arsenide and cadmium sulfide are under study for thin film solar cells. While silicon has yielded the most efficient and economical solar cells to date, it may not prove to be the most suitable material for thin cells, according to Martin Wolf, general manager of Heliotek Corp. Silicon, he explains, reacts with most known materials making processing techniques difficult. It has relatively small absorption coefficients for light at longer wavelengths, which would necessitate use of relatively thick films for solar energy conversion, and it requires a p-n junction to obtain reasonably high conversion efficiency. The latter imposes rather high requirements on crystalline perfection of the film. While these problems may be overcome, it is doubtful, he says, that a silicon thin film solar cell will soon become a practical device.

Cadmium sulfide cells with copper contacts, based on a photo-emissive process at the copper-cadmium sulfide interface, rather than on an absorption and carrier generation process within the crystal lattice of the semiconductor, show substantial promise for thinner film solar cells, Wolf says. Since no potential barrier outside of the copper cadmium sulfide interface is needed in this mechanism, the high requirements which a p-n junction imposes on crystalline perfection are deleted, he points out.

Among the organizations studying thin film solar cells and/or conducting research and development with these cells are:

- **Radio Corp of America**—David Sarnoff Research Center is conducting thin film solar cell research with cadmium sulfide, silicon and other materials in both polycrystalline and single crystal



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**Tailoring of environment is a vital requirement that must be built into today's weapons systems. Answering this need is specially designed AAF equipment for controlled environment. For example, AAF-engineered air conditioners were developed for the APCHE system. The units are installed in mobile vans used for prelaunch checkout of the Atlas missile. They provide conditioned air for personnel and for sensitive electronic equipment in the van.**

**Other AAF equipment supporting modern weapons systems include heating equipment utilizing various fuels or electric power, also packaged liquid chillers, heat exchangers, specialized blowers. You can increase your system reliability with AAF know-how and equipment.**

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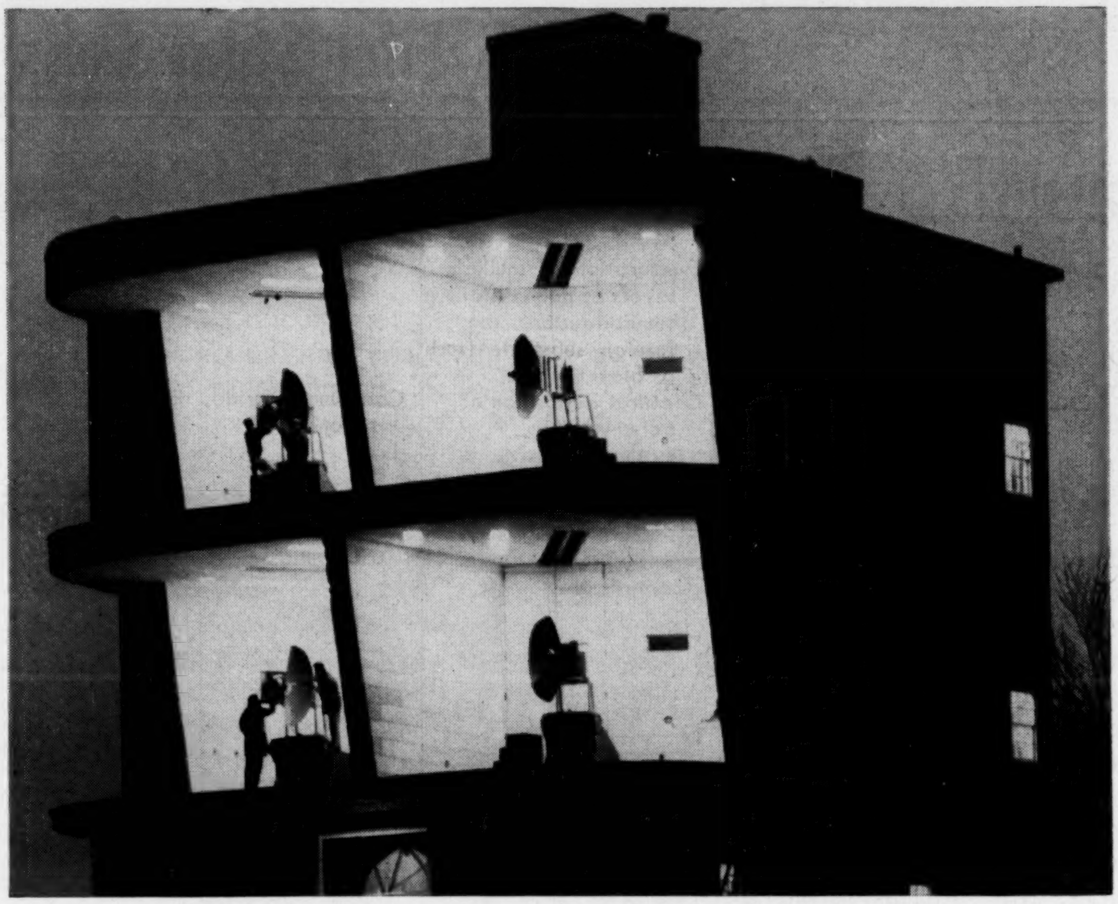


## Tower Tests B-52 Radar Antennas

**Radar test tower, one of two 65-ft.-high structures built by Raytheon at Waltham, Mass., for testing radar antennas used in B-52 bomb-navigation system. Each of the four bays is lined with microwave-absorbent material to duplicate free-space propagation conditions and prevent reflection of stray microwave energy. Roll-top-desk type doors can be moved into position to protect equipment and engineers during bad weather.**

form with the latter presently favored. Efficiencies in excess of 4% have been measured. RCA estimates that film solar cells will be available for space applications in 2 to 5 years. These would be well suited for use in unfolding arrays running up to 3 kilowatts.

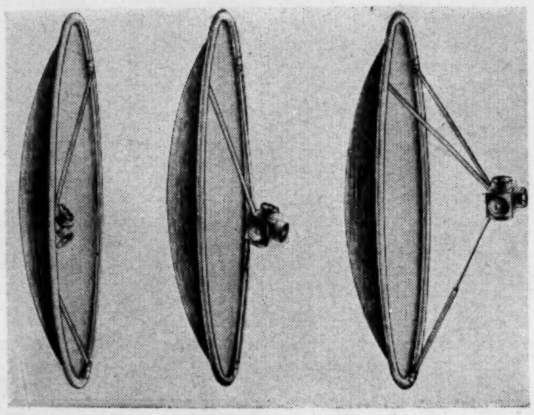
- **Army Signal Research and Development Laboratory**—Research presently is being conducted on polycrystalline films deposited on non-silicon substrates by decomposition of silicon tetrachloride in an atmosphere of hydrogen. Of several approaches explored in external efforts, none has produced practical results, a laboratory spokesman indicates.
- **General Dynamics Astronautics**—Under an internally supported research program, the company is investigating photovoltaic conversion using principally cadmium sulphide-cuprous oxide junctions. These materials permit reasonably high conversion efficiencies (with efficiency up to 5% expected) in polycrystalline form and can be deposited in layers five microns thick with good characteristics, according to George J. Mealey, head of the Electronics Research Laboratory. Polycrystalline films are preferred because they are less difficult to fabricate, and are less sensitive to stresses and other environmental influences.

Vacuum deposition and sputtering processes are under study. The former permits use of a variety of evaporation methods while the latter is more economical. Sputtering also permits direct coupling of working volumes between independent sputtering systems; thus, several materials may be deposited simultaneously and in sequence on material being pulled through each system.

Power density anticipated from this thin film solar cell work is ½ watt per sq. ft. Cost, Mealey says, is expected initially to be about $100 per watt with $10 per watt regarded as a reasonable follow-on goal. A factor of 100 reduction in weight compared with conventional solar energy conversion systems may be possible. Films 4 in. wide and virtually unlimited in length appear feasible.

Thin film solar cell systems may be available in sizes up to 100 watts by 1963, larger area systems are feasible by 1965 for conversion systems to be placed on the lunar surface, Mealey predicts.

- **Minneapolis-Honeywell** — Long-range research program on polycrystalline silicon films, varying from 1 to 3 mils in thickness, has produced cells with efficiencies of 1%, open circuit voltage of 0.35 v., short circuit current of 3 to 4 milliamps per cm. squared (AW Feb. 27 p. 69). Junctions are double diffused into the film after deposition on one of several substrates.
- **Heliotek Corp.**—Company-sponsored study on thin film solar energy conversion devices is in progress and is expected to grow into a full research and



## Satellite Solar Converter

**Artist's concept of solar energy converter which would focus sun's heat on cathodes of cesium thermionic diodes, thus causing current flow through a load and converting heat to power. System is being developed by Electro-Optical Systems, Inc. for Jet Propulsion Laboratory under $318,000 contract. System, with 5-ft-diameter collector, is designed to provide 135 watts of power for space vehicle operating in vicinity of Mars (AW Feb. 20, p. 33). Three views show converter in stored, unfolding and operating modes (left to right).**

development program in the future.

- **Clauser Technology Corp.**—Company is studying solar cells composed of multiple layers of polycrystalline films deposited on dielectric substrates. Purpose would be to boost efficiency (theoretically up to 38%) by depositing many layers (each approximately one micron thick) one atop the other into a multilayered cell, capable of absorbing all of the sun's photons. Effort would be made to align crystallites within each film so that they look like single crystals in depth of film.
- **Merck & Co.**—Epitaxial techniques developed for making p-n junctions have been applied to thin film structures and these are under study as solar cells. Single crystal silicon cells as thin as four or five mils have been made in sizes up to 6 in. by ¼ in. These are cut to an area ½ to 1 sq. cm. for evaluation of electrical properties. Company-sponsored research is concerned with applying the basic techniques of epitaxial growth to the production of thin film structures for highly efficient, lightweight and inexpensive solar cells.
- **Hoffman Electronics Corp.**—One objective of a Hoffman Science Center long-range experimental study of semiconductor thin films is the development of new techniques and materials for use in large area thin film solar cells. This work is primarily concerned with silicon although other materials such as gallium arsenide are included. The program is built around polycrystalline films and uses chemical decomposition and vacuum evaporation. Dr. Ralph P. Roth of the Science Center expects polycrystalline silicon solar cells in areas up to 1 sq. ft. and pro-

# air density problem:

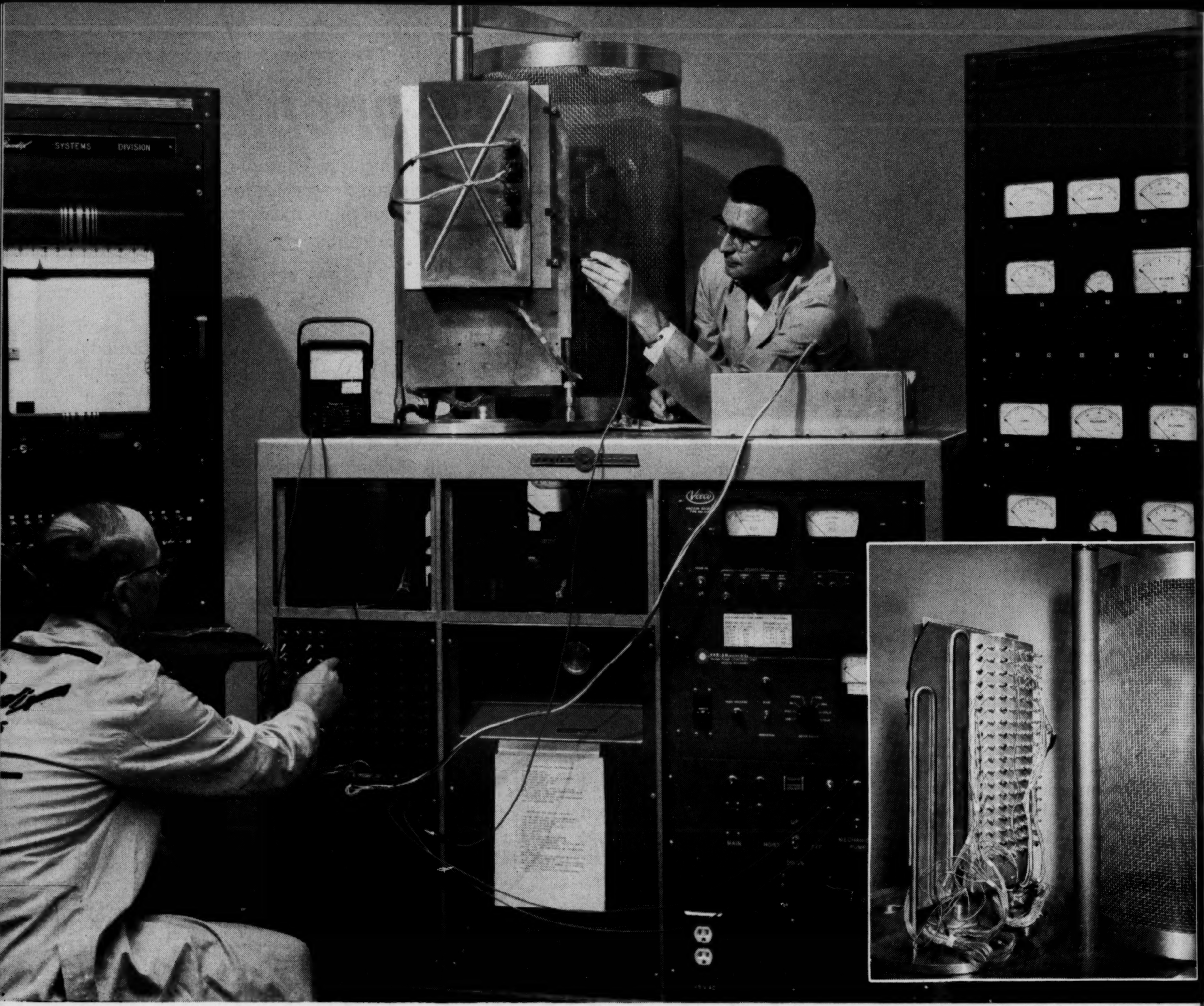
Design light, compact ionization gages to measure atmospheric pressure and density 125 miles up. Gages must withstand acceleration and vibration during initial launch, yet be sensitive enough to measure thousandths of millimeters of mercury.

# solution:

Westinghouse built several ionization gages for NASA's Aerobee-Hi Sounding rocket. One of these gages, tested at Wallops Island, Va., gained direct measurements of pressures and densities at 70 to 125 miles up. With a sensitivity range of 1 x $10^{-3}$ to 1 x $10^{-10}$ mm of mercury, the gages are expected to record data in the thin atmospheres of near space. To achieve this, Westinghouse developed tube elements of extremely low mass, as well as new techniques for mounting them. For help in resolving your avionic problems, contact your Westinghouse sales engineer. Or write: Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pennsylvania. *You can be sure . . . if it's Westinghouse.*

J-92517

**Westinghouse**



Satellite communications packages are mounted on the reverse side of this simulated satellite "skin" to experimentally obtain heat-transfer data. The 15" x 30" vacuum chamber permits testing in a space environment.

**REMOVING "HOT SPOTS"** from electronic packages is a prerequisite to achieving the reliability required for advanced satellite communications systems. Individual components—resistors, transformers, capacitors, transistors—must be mounted so as to duplicate in space the same thermal environment for which expected MTBF values have been established in the laboratory. This thoroughness in developing and testing electronic circuits, with special emphasis on heat transfer, is a key to Bendix reliable space communications equipment. Our team of communications experts is in the forefront of this advancing space technology. Positions on this team are open to better scientists and engineers.

**BENDIX SYSTEMS DIVISION**
ANN ARBOR, MICHIGAN

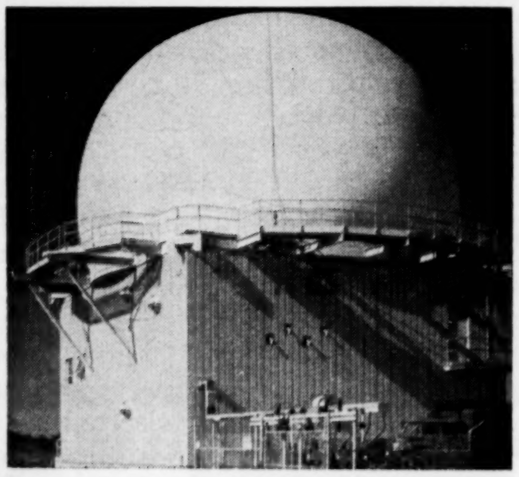
THE Bendix CORPORATION

viding efficiencies from 5 to 8% to be available from this program within two years.

- **General Electric**—Thin film polycrystalline cadmium telluride and silicon solar cells are being investigated by the Advanced Semiconductor Laboratory of General Electric. Dr. James F. Elliott is heading the program (AW Oct. 17, p. 63). Work is supported by Air Force's Aeronautical Systems Division and the Army Signal Research and Development Laboratory. General Electric is preparing films of silicon by chemical deposition and cadmium telluride by evaporation. Both processes, according to Elliott, lend themselves to a continuous manufacturing process. Determining what the electrode configuration will be for the total power supply is a major engineering problem.
- **Harshaw Chemical Co.**—Cadmium sulfide film cells with direct sunlight conversion efficiencies up to 3.5% have been achieved by vacuum evaporation on various heated substrates. Cadmium sulfide films formed from purified and doped cadmium sulfide single crystal chips are macrocrystalline (on the order of millimeters), have resistivities less than an ohm-cm. and good optical transmission. Backwall cells have been made from these films deposited on conducting tin oxide coated glass employing the same barrier forming process as used on single crystal cadmium sulfide cells. Backwall here refers to the conversion process near the incident surface followed by diffusion of charge carriers to a barrier in the neighborhood of the surface. Work is supported by USAF Aeronautical Systems Division contracts. Solar energy conversion efficiencies up to 4 or 5% are expected to come about with better, modified processing.
- **Lear**—Company's Solid State Physics Laboratory has studied the applicability of its epitaxial process to thin film solar cell fabrication. David William Moore, manager of the laboratory, feels that the thickness of film solar cells will have to be a compromise between two conflicting requirements. One is to restrict film thickness to 5 microns to achieve maximum resistance to nuclear radiation. The other is the need to have films at least 35 microns thick for efficient conversion. As a possibility for retaining efficiency at thicknesses less than 35 microns, Lear intends to investigate light-trapping techniques which will enable light to pass back and forth through the film.

Early thin film solar cells might be available for space applications as early as next year, Martin Wolf says. These cells, however, will have efficiencies essentially below those of conventional silicon and gallium arsenide cells and their reliability will be an unproven factor. They might be used with inflatable structures, of the unoriented sphere or oriented flat panel type.

The thin film solar cell power supply will not be useful where the total surface area is the limiting factor as it is in present satellite configurations. GE's Elliott expects that thin film cells could find space application where powers on the order of a thousand to a million watts are desired.



## Height-Finder Radar

**AN/FPS-26 high-power height-finder radar at Hunter AFB, Ga., is first of new production sets to be turned over to North American Air Defense Command. Built by Avco's Electronics and Ordnance Div., the FPS-26 antenna is housed in 55-ft.-dia. radome.**

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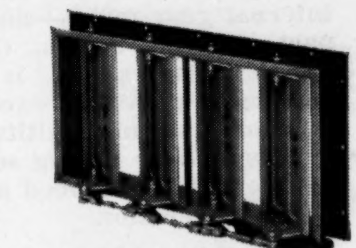
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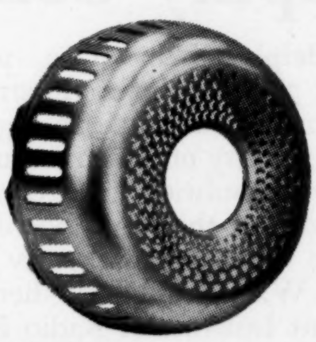
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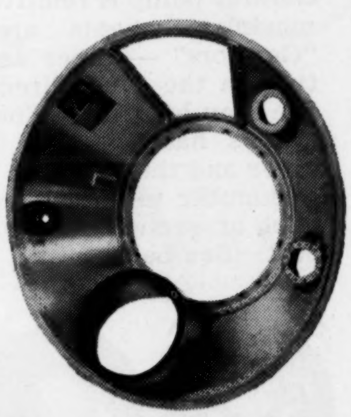
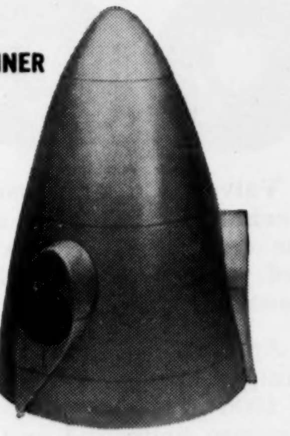

ACCESS DOOR

AIRCRAFT DOOR

PROPELLER SPINNER


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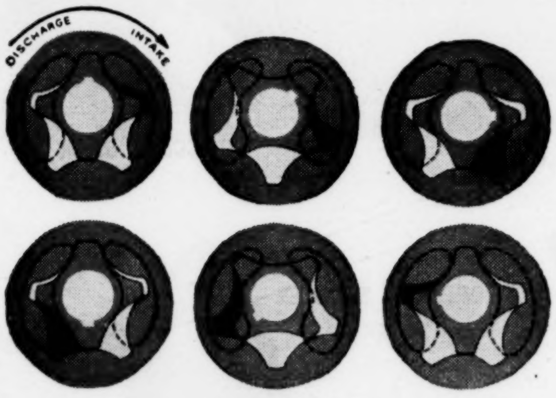
VALUE ANALYSIS REVEALS GEROTOR'S UNIQUE ASSETS

► The rather unusual qualities of the Gerotor pump which have kept it intimately associated with aircraft pumping applications from the days of the earliest superchargers for reciprocating engines, can best be summed up as *inherent adaptability* and *high reliability.*

► **The Gerotor pump is a positive displacement type, delivering a predetermined amount of fluid in direct proportion to speed. It is a form of internal gear pump—simple and compact in basic design, (has only two moving parts). It is lightweight, valveless, provides exceptional performance at high altitudes and has low wear over a long service life. In addition, it is balanced and extremely quiet in operation.**

► Structure and operation of the Gerotor pump is relatively simple. The moving elements are the toothed "Gerotors" — inner and outer. Both turn in the same direction and either one may be driven. The inner element always has one less tooth than the outer and the "missing tooth" provides a chamber to move the fluid from the inlet or suction port to the discharge port. (See below).



► **Valveless design insures absence of mechanical troubles associated with the operating complexity and service and wear problems inherent in valve construction.**

► Applications for Gerotor aircraft pumps lie in the range of pressures up to 1000 psi. They are suitable for low pressure hydraulic and servo systems, hydraulic motors, lube, scavenge and booster service, electronic coolant pumping in aircraft and guided missiles, and similar applications.

► *Technical data is available and your inquiry is invited. Write:*

**W. H. NICHOLS CO.**

Makers of Zenith Metering Pumps
and the Nichols Milling Machine
"the miller that uses its head".

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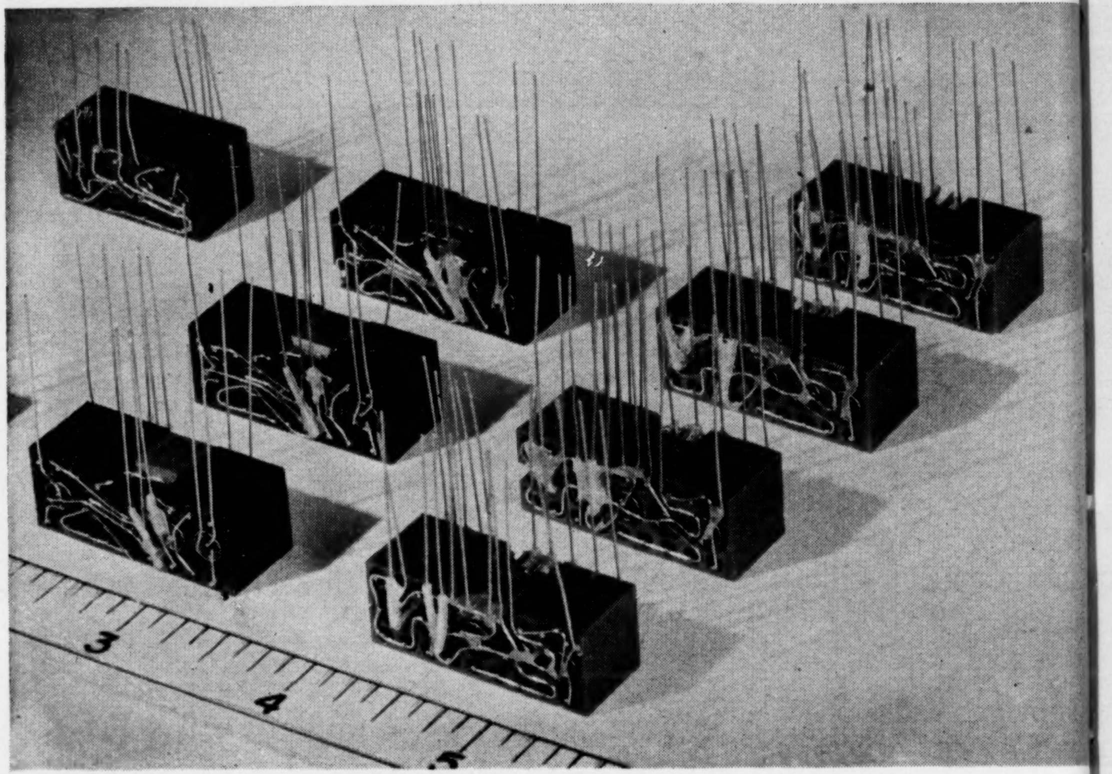


**WELDED HONEYCOMB MODULE** developed by Sperry Gyroscope for high-density av circuit packaging is expected to ease fabrication and component replacement as we improve performance and reliability. Metal or plastic blocks are cast or drilled to accom date different size components which then are interconnected by welding. Exposed are then encapsulated to seal module.

# Welded Honeycomb Modules Simplify Component Replaceme

**Philadelphia**—Use of a preformed metal or plastic honeycomb structure to house components used in high-density welded circuitry offers important advantages over sandwich type construction using films on thin fiber boards to support the components, Sperry engineer Charles W. Johnson said here during the recent Institute of Radio Engineers conference on production techniques.

Sperry Gyroscope has adopted the welded honeycomb structure technique for high-density packaging in a number of avionic systems now under design by the company, Johnson reported.

Although neither welded circuitry nor honeycomb structures for housing components are in themselves new, the combination of the two is expected to ease a number of previous welded circuit manufacturing and reliability problems, Johnson indicated.

Sperry's approach is to use small metal or plastic blocks containing holes which have been drilled or cast into the block. Each hole diameter matches the component which will be inserted into it. After component insertion, capacitor discharge welding is used to interconnect individual component leads into the required circuit on opposite sides of the honeycomb block. When circuit is completed and has been tested, the entire unit can be sealed by vacuum encapsulation.

Johnson described some of the manufacturing problems that occur with the more familiar sandwich-type welded cuit construction and how these eliminated or minimized with the honeycomb structure:

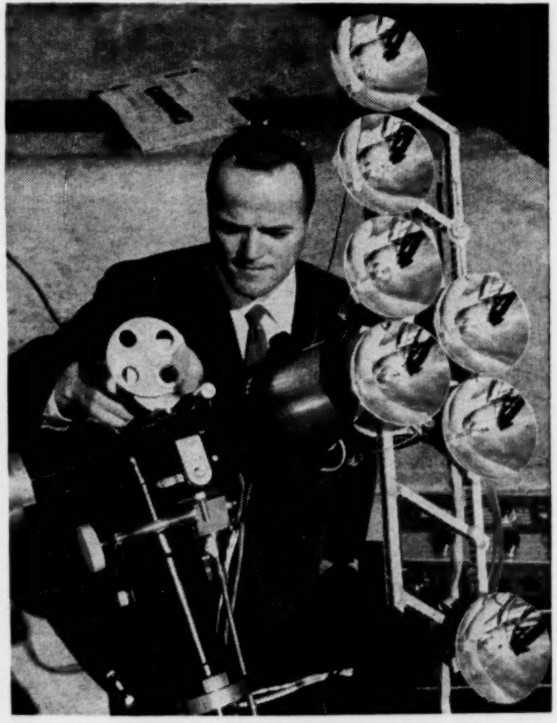
- **Accessibility:** In sandwich-type struction, replacement of a defec component is extremely difficult the sandwich has been completed wired but is relatively easy with honeycomb structure. If low-temp ture curing silicone resin is used honeycomb encapsulation, a defec component can be replaced easily e after complete encapsulation by us a pen-knife or cork borer to expose faulty component.
- **Component insertion:** In sandw type construction, all components m be inserted before welding intercon tions can be made, resulting in a m of component leads and the increa possibility of wiring error. With hon comb, components are interconnec individually as they are inserted. T insert-weld-insert-weld sequence, compared with an insert-all, weld sequence, also provides more acce bility for the welding electrode.
- **Component variations**: Separation tween the body of adjoining com nents, which determines their int component capacity, can have an i portant effect on circuit performan In sandwich type construction, t separation is determined by the locati of the axial leads on each compon which is subject to considerable va

tion. With honeycomb construction, the position of each component body is controlled by the pre-drilled or cast holes which can be controlled more precisely, according to Johnson.

- **Reliability:** Encapsulation of a sandwich-construction circuit can result in injurious stresses on components, not readily detectable, which speed component failure. Additionally, invisible voids in the encapsulating material can cause hot spots to develop which also speed component failure. With honeycomb construction, the major portion of the encapsulation is in place before the components are inserted so that final encapsulation to enclose the two ends should not produce injurious stresses and voids are minimized.

Johnson pointed out that feedthrough wires can be cast in the honeycomb block and that grooves can be cast in the surface to provide cross-over connections without shorting or increasing the over-all module dimensions. Where considerable heat must be dissipated from the circuit, anodized aluminum honeycomb blocks can be used to improve module cooling.

The honeycomb technique can accommodate components with other than cylindrical form factors, including integrated microelectronic circuit packages, merely by casting holes of the required shape. Johnson said that Sperry had adopted the welded honeycomb construction after evaluating about a dozen different packaging techniques.



**Solar Generator Model**

**Solar thermo-electric generator, using seven small reflectors, is pilot model of a 50-reflector space power system which Hamilton Standard Division of United Aircraft Corp. soon will deliver to Air Force. Reflectors are attached to equatorial mount to automatically follow the sun. (Image in reflectors is photographer standing on a ladder.)**

**navigation problem:**

Prevent loss of directional and positional information by providing ultra-reliable, closely regulated power supply for SINS (Ships Inertial Navigation System) for nuclear submarines.

**solution:**

Westinghouse is delivering static inverters to the Navy to take the place of motor generator sets previously used in SINS. Since SINS could conceivably swing out of calibration, all direction and position reference could be lost. The submarine would have to surface to recalibrate. So the Navy turned to Westinghouse for solid state inverters, used for the first time in the operation phase of SINS. These unique inverters have no moving parts. They permit lower noise operations and reduce maintenance while helping SINS equipment maintain stable and absolute directional accuracy. Contact your Westinghouse sales engineer on your challenging electronic component problems. Or write: Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pennsylvania. *You can be sure . . . if it's Westinghouse.*

J-92518

**Westinghouse**

LING-TEMCO

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*Proposed new name for the combined companies after August 31, 1961. CHANCE VOUGHT CORPORATION AND LING-TEMCO ELECTRONICS, INC.

The stockholders of Chance Vought Corporation and Ling-Temco Electronics, Inc., on June 30, 1961, approved plans for combining these two companies into a vast, new company — Ling-Temco-Vought, Inc., to be effective August 31, 1961.

Combination of these dynamic, experienced organizations will link depth of capabilities with depth of management to meet the advanced challenges of electronics, space, communications, aircraft, missiles, industrial and consumer developments.

Ling-Temco-Vought will employ more than 20,000 people in seven basic groups: AEROSPACE SYSTEMS... ELECTRONICS... COMMUNICATIONS . . . COMMERCIAL AND INDUSTRIAL PRODUCTS... SOUND SYSTEMS... AERO SYSTEMS... INFORMATION HANDLING SYSTEMS.

This will be . . . Ling-Temco-Vought, Inc. . . . a new industrial leader to serve America's exciting future through science.

from left

James J. Ling
Chairman of the executive committee

Robert McCulloch
Chairman of the Board

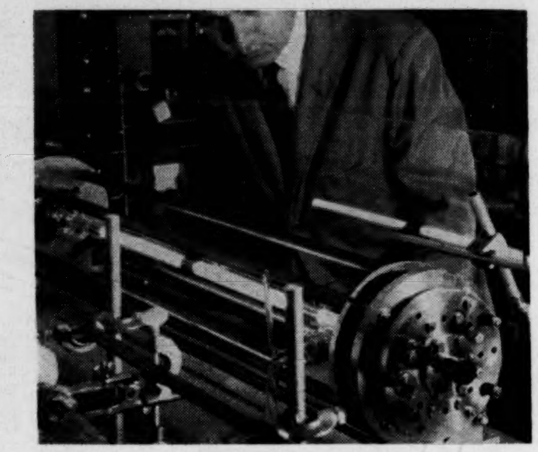
Gifford K. Johnson
President

Clyde Skeen
Executive Vice-President

VOUGHT, INC.*

LTV

DEPTH
MANAGEMENT
FOR PROGRESS
IN AEROSPACE
ELECTRONICS
COMMUNICATIONS
AND CONSUMER PRODUCTS



**Laser Demonstrated**

**Optical gas maser (laser), which uses helium and neon to produce coherent light at wavelength of 1.15 micron in the infrared region, has been demonstrated by Raytheon's Research Division. The device, which weighs about 35 lb., is similar in principle to gas maser developed by Bell Telephone Laboratories. Raytheon device is built on low-expansion Invar-rod frame to permit easy replacement of critical parts.**

## Ling Builds Amplifier For Project Artemis

Large, water-cooled sonar amplifier, designed to power a sonar transducer used in the Navy's Project Artemis, has been built by Ling Electronics Division of Ling Temco Electronics.

The sonar amplifier and related equipment for Project Artemis have been installed in a former Navy tanker, the USNS Mission Capistrano, modified to carry high-power equipment. The ship is fitted to raise and lower the transducer, which is five stories high and weighs several hundred tons.

Mission Capistrano is operated by the Military Sea Transportation Service for Office of Naval Research, and it will cruise in the Atlantic Ocean during tests.

Hudson Laboratories of Columbia University is prime contractor on Artemis, and some 30 university, government and industry organizations are involved in the advanced Navy antisubmarine warfare project.

## FILTER CENTER

► **Solar Cell Spheres**—In an effort to obtain more power for a given amount of surface area from solar cells, Hoffman Electronics has been studying the use of spherical-shaped solar cells. The spheres are on the order of millimeters in diameter and a multiplicity of them, made by conventional diffusion techniques, can be interconnected. Value of the approach lies in the fact that an entire half hemisphere rather than a flat surface area could be exposed to sunlight. This would increase the power output but also boost the weight per area. Studies have been supported by the Army Signal Corps.

► **Titan II Site Communications**—Series of field propagation tests of UHF communications were conducted during the past year for the Air Force by Electronic Communications, Inc., in anticipation of requirements for Titan II site communications system. Company attempted to determine feasibility of using low-elevation antennas (5 to 12 ft.) to communicate over-the-horizon along relatively short paths (20 to 50 mi.) at moderate UHF RF power levels (up to 1 kilowatt). In tests conducted at McConnell AFB (Wichita, Kan.) measured path losses for identical transmit and receive yagi arrays using vertical polarization were within ±10 db. of predicted values, whereas horizontal polarization figures exceeded predicated values by greater amounts. Maintaining directional stability and erecting and lowering antennas above a 10 ft. elevation was difficult because of high winds in Wichita area during late winter and early spring when tests were conducted. Previous tests were conducted by Electronic Communications in the vicinity of St. Petersburg, Fla. and Davis-Monthan AFB (Tucson, Ariz.). Summary of results of company's tests were provided by Air Force to each company submitting a bid in current competition for Titan II site communications system (AW July 10, p. 19).

► **Earth Current Communication Systems Use to Grow**—Use of earth currents (AW May 18, 1959 p. 26) for transmission of electromagnetic energy appears to be gaining favor with the Air Force for some of its command systems. There are indications Air Force may select earth current communication systems for its 480L and 477L command systems. Earth current systems refer to those which have transmitting and receiving antennas buried in the earth. They encompass two basic approaches—the transmission of energy directly through earth strata or via surface waves at the interface between the earth and the air. A system of the latter type is being built by Sylvania for communication among Minuteman ICBM sites.

► **Signs of the Semiconductor Times**—Among recent indications of tightening in the semiconductor business (AW June 12, p. 72) are the following:

- **Transitron Electronic Corp.** indicates final quarter Fiscal 1961 (ended June 24) sales figures were $8.5 million, based on unaudited figures, compared with $12.6 million for like 1960 quarter. Fiscal 1961 sales apparently were $39.5

BLAISDELL *Announces*
the addition of LAMINATED
BRASS
SHIM STOCK

**LAMINATED BRASS** has now been added by Blaisdell to their line of laminated aluminum, 1010 steel and 301-302 stainless steels. Laminated brass available as stock item 12"x48"; widths to 24" available on special order. For further information, write:

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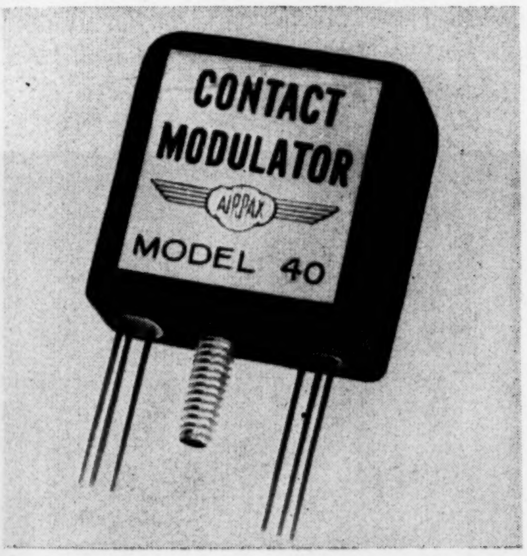
million, down from $47.7 million in the previous year. Semiconductor products account for almost all of the sales of this company, rated the second largest semiconductor manufacturer in 1960.

- **Several investment newsletters** are advising potential investors to exercise more caution with so-called "glamour" semiconductor issues.
- **Hoffman Electronics** will de-emphasize transistor R&D, putting more emphasis on high power rectifiers, zener diodes and controlled rectifiers while maintaining current transistor lines. Company is completing regrouping its low-power devices in El Monte, Calif., plant, high-power devices in Evanston, Ill., facility.
- **Continuing drop** in transistor prices is reported to be pinching most if not all producers. President of one semiconductor firm assured stockholders that future is still bright in semiconductor business, another president predicts an appreciable shakeout in next four years.

## NEW AVIONIC PRODUCTS

- **Midget low-noise chopper,** Model 40, designed for 400 cps. use, can withstand 100g shock and vibration in any direction from 10 to 55 cps. and 15g from 55 to 2,500 cps., according to manufacturer. Signal level is up to 10 v.d.c. at 2 ma. maximum current. Hermetically sealed unit can operate over temperature range of minus 65C to 100C and has rated life of more than 2,000 hr. Chopper weighs 9 grams and measures $\frac{21}{32}$ x $\frac{21}{64}$ x $\frac{5}{8}$ in. Manufacturer: Airpax Electronics, Inc., Cambridge Division, Cambridge, Md.



- **Subminiature rotary switches** come in nominal 1-in.-diameter size. Series 7000 provides 12 live switching contacts and 4 poles per deck, while Series 5000 provides up to 24 switching contacts and up to 8 poles per deck, using contacts on the front and back of the deck. Switches employ MIL-standard quality materials; deck wafers are made

**reliability problem:**

Drastically reduce downtime of T-R units in aircraft. Achieve a high degree of reliability. Increase operating time by reducing unscheduled removals for maintenance. Keep cost of equipment comparable to conventional unit.

**solution:**

Westinghouse furnished silicon power rectifier cells for use in new transformer-rectifier units. These units have had only one recorded removal in 100,000 hours operating time. Best operating performance by previous units was 20,000 hours between unscheduled shutdowns. The Westinghouse T-R units are used in the C130A and B aircraft manufactured for the Air Force by the Lockheed Aircraft Corporation, Marietta, Ga. Each unit converts 115-volt, 17.5-ampere, 400-cycle power to direct current at 27 volts and 200 amps. Compare this record with a motor-generator set that performs the same function. The use of the static transformer-rectifier eliminates moving parts that would otherwise require changing of brushes and bearings seventy times, changing the rotor thirty times, in a comparable 100,000-hour life period. Ideas and products like this one can save you man-hours and maintenance time while hiking your reliability results. Contact the Westinghouse sales engineer. Or write: Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pennsylvania. *You can be sure . . . if it's Westinghouse.*

J-92519

**Westinghouse**

# This is systems capability a

Many of the significant advances in electromechanics, electronics systems, environment systems, and other areas, were originated and brought to fruition at the Columbus Division of North American Aviation. A complete center of advanced systems technology, the Columbus Division has the minds and facilities to convert original concepts into practical hardware with economy and efficiency. This is true systems capability... this is the Columbus Division.

**COLUMBUS DIVISION OF**
**NORTH AMERICAN AVIATION**
Columbus, Ohio

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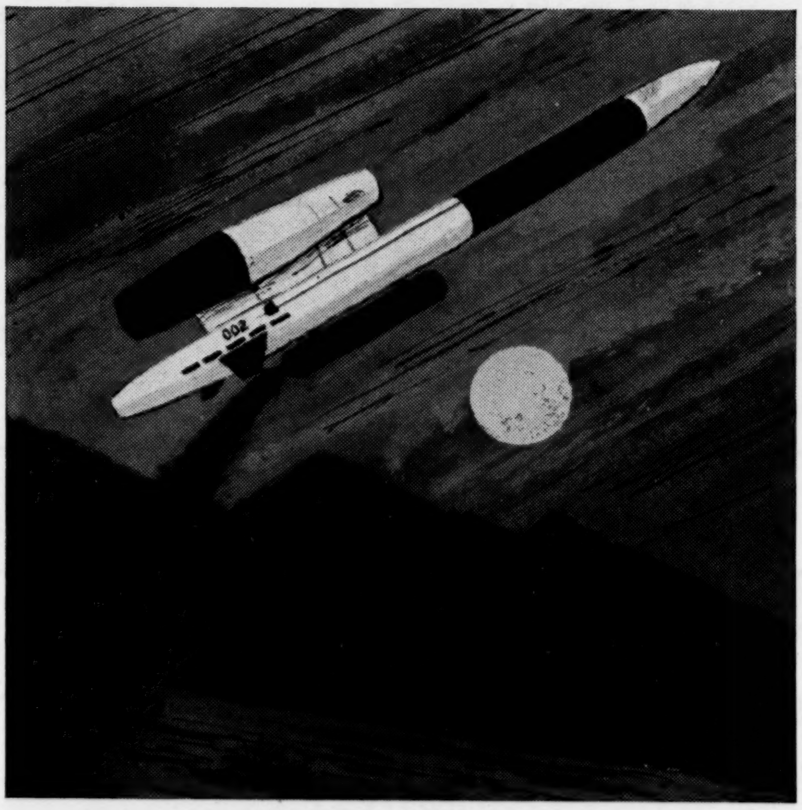
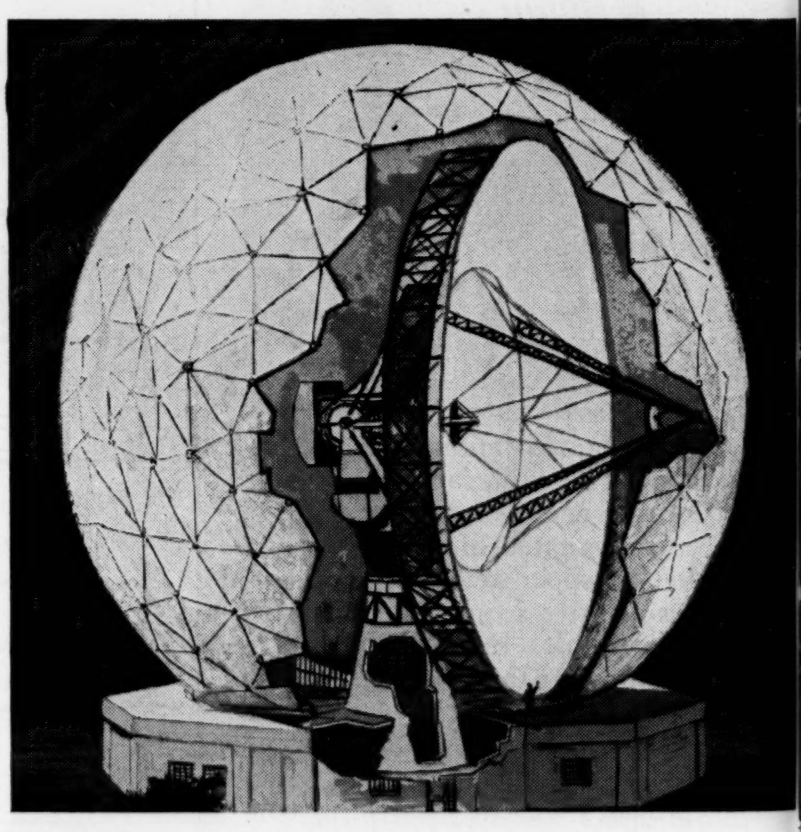


DOUBLE DUTY. NAA-Columbus is building the complete Army Redhead-Roadrunner target missile system. This economical new missile will fly subsonic or supersonic missions and will operate at altitudes up to 60,000 feet.



"HAYSTACK HILL" ANTENNA. A 120-ft. antenna system, using a new concept that distributes tension evenly to avoid distortions in readings, is being built by Columbus for USAF on Haystack Hill near Boston, Mass.

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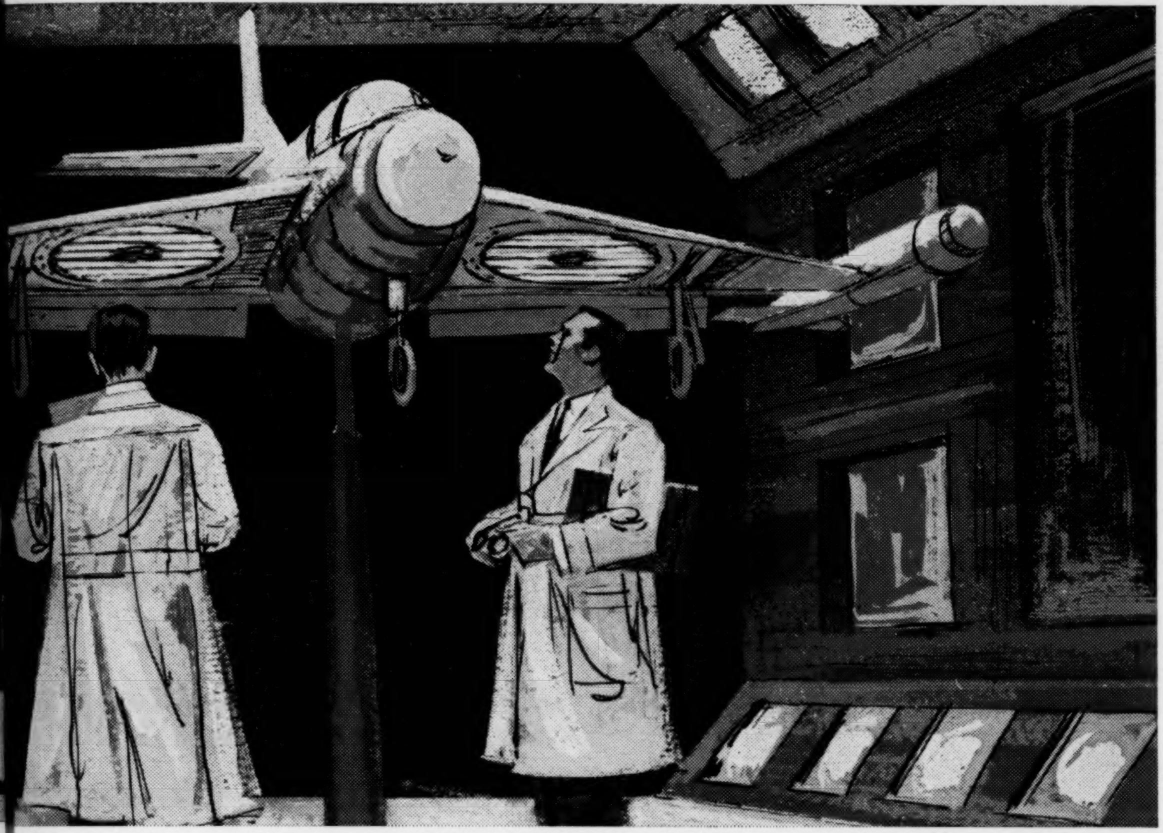
# at NAA-Columbus



V/STOL FACILITIES. NAA-Columbus has one of the largest wind tunnel V/STOL design testing sections in the world (14 feet wide by 16 feet high). This is part of the extensive V/STOL facilities Columbus has used in the development of both lift-fan and tilt-wing aircraft which need no runway for take-off or landing.

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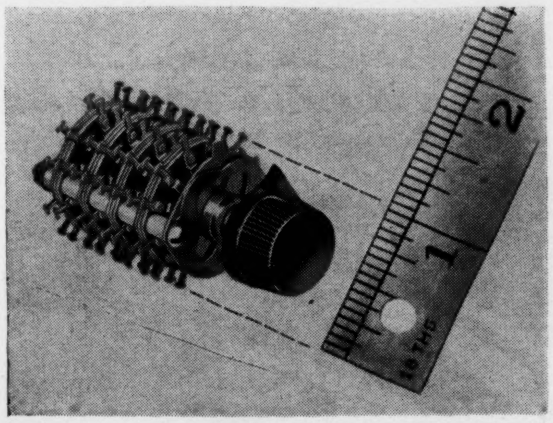
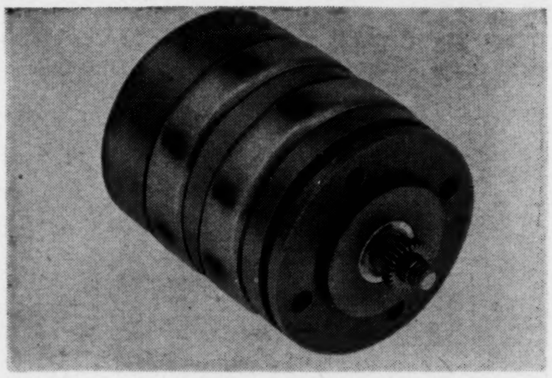
ANTI-SUBMARINE WARFARE. NAA-Columbus is at work on new applications of anti-submarine warfare to meet the threat of highly advanced submarines. Other research and development projects at Columbus include advanced battlefield surveillance, and surface-to-air and surface-to-surface missile systems.

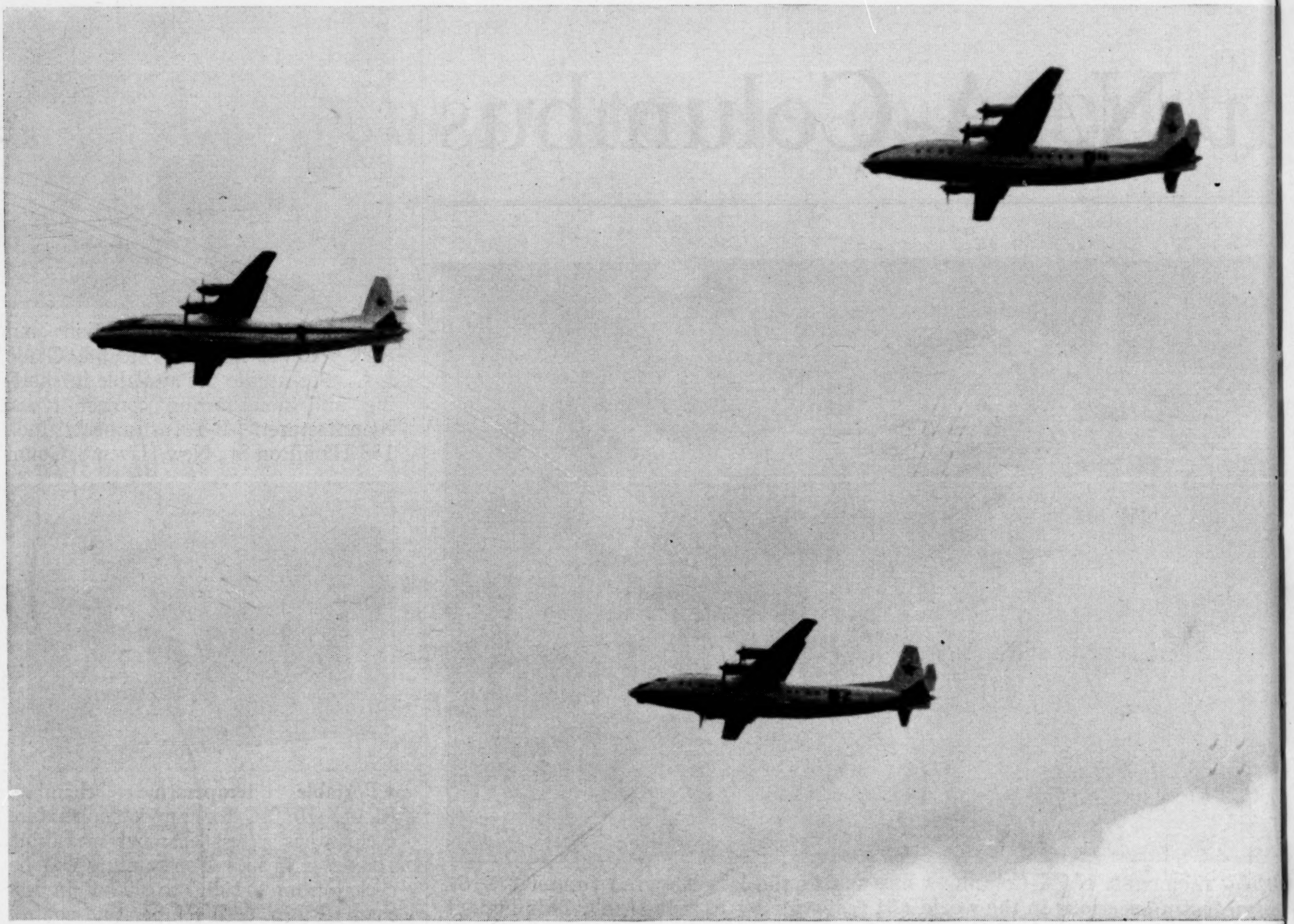


of epoxy glass fabric laminations and deck rotor is made of Steatite Grade L-4. Both series are available in shorting and non-shorting contact types. Manufacturer: J-B-T Instruments, Inc., 133 Hamilton St., New Haven 8, Conn.

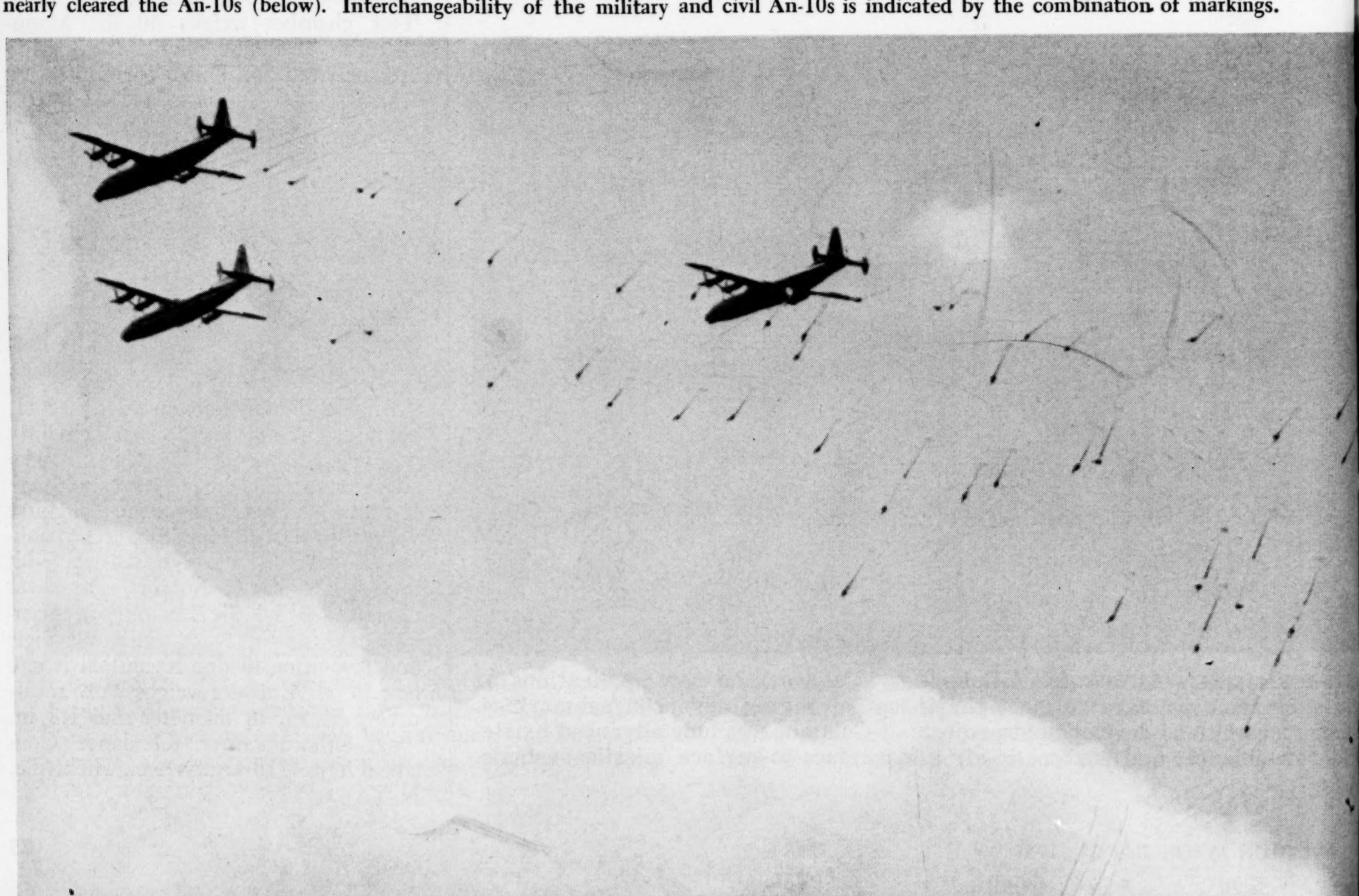
• **Portable temperature chamber,** Model 1060F, for rapid temperature cycling has a test chamber measuring 10 x 7 x 7 in. Temperature can be cycled from −100F to 500 F in less than 12 min. with temperature control accurate to within ½ deg. F. At −65F temperature, device consumes less than 3½ lb. of carbon dioxide per hour. Test chamber weighs 40 lb. Manufacturer: Delta Design, Inc., 3163 Adams Ave., San Diego 16, Calif.

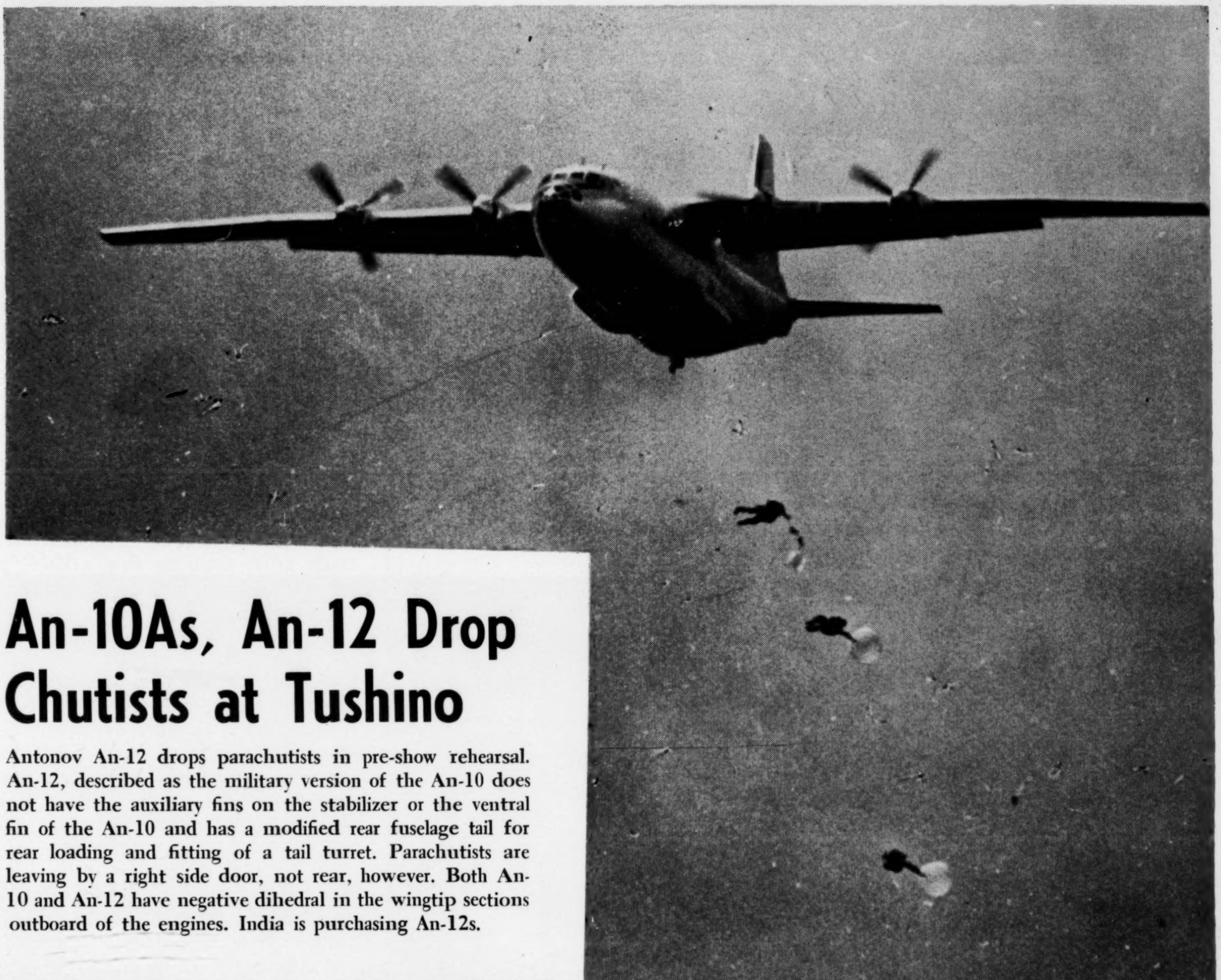


• **Analog/digital shaft encoder,** size 11, contains all required logic circuitry within the encoder package. Model shown, the ADC-11-11, employs binary V-scan, self-selecting logic circuitry with silicon switching diodes for nonambiguous readout. Device uses 6-bit and 5-bit disk to obtain its 11-bit capacity, or 2,048 count output. Accuracy is ½ of the least significant digit and resolution in one revolution is one part in 64. Encoder weighs 2 oz., measures 1.06 in. in diameter and 1.5 in. long. Manufacturer: Guidance Controls Corp., 110 Duffy Ave., Hicksville, N. Y.



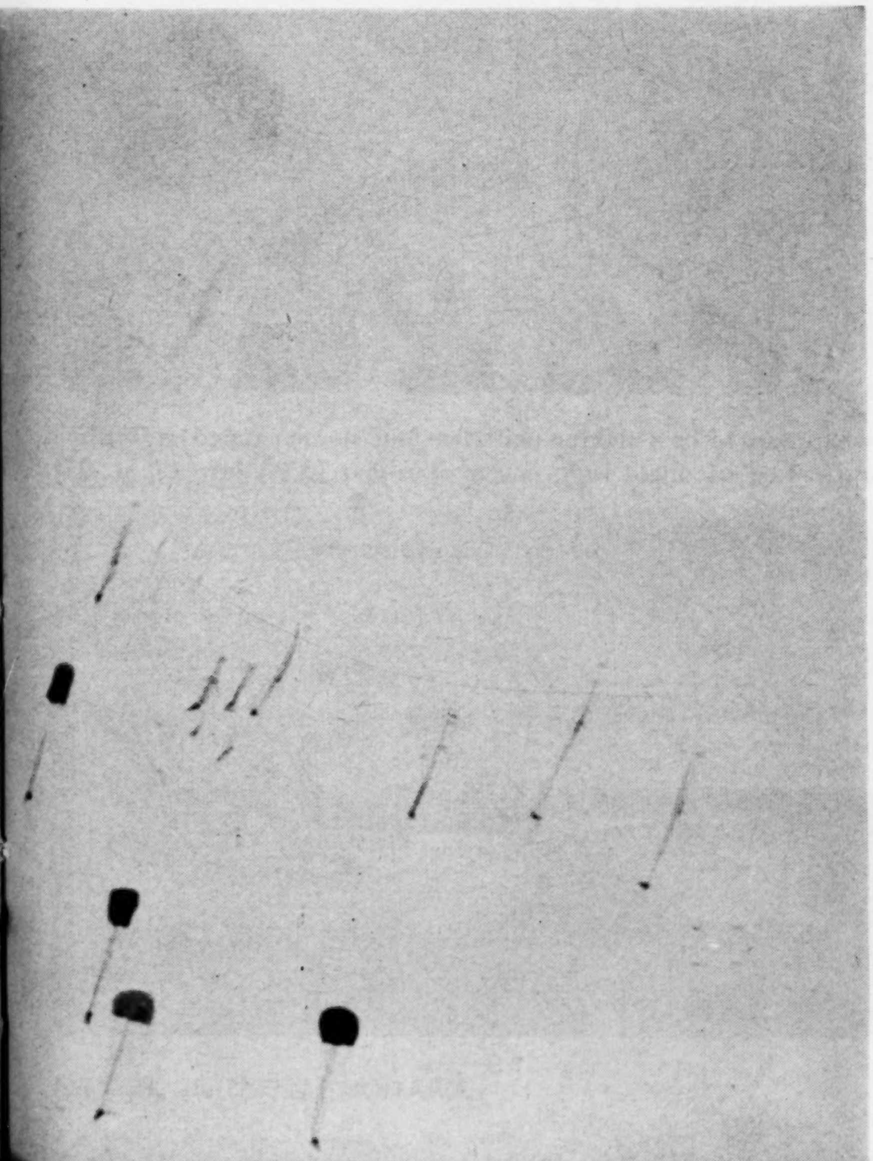
Formation of three Antonov An-10As—the lead airplane in markings resembling Aeroflot's—flies by at the Tushino air show (AW July 17, p. 26; July 24, p. 26). Flaps are partly extended and rear doors are opened prior to dropping paratroops (above). Parachutists have nearly cleared the An-10s (below). Interchangeability of the military and civil An-10s is indicated by the combination of markings.

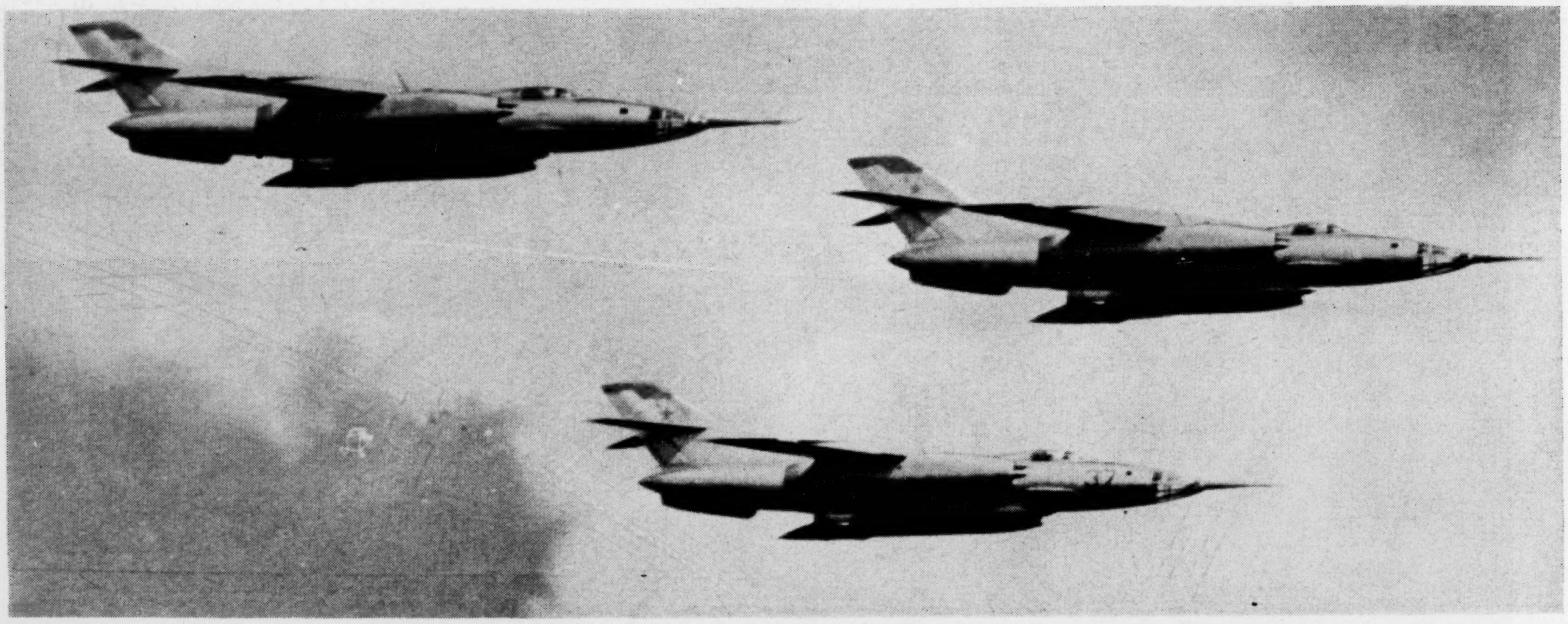




# An-10As, An-12 Drop Chutists at Tushino

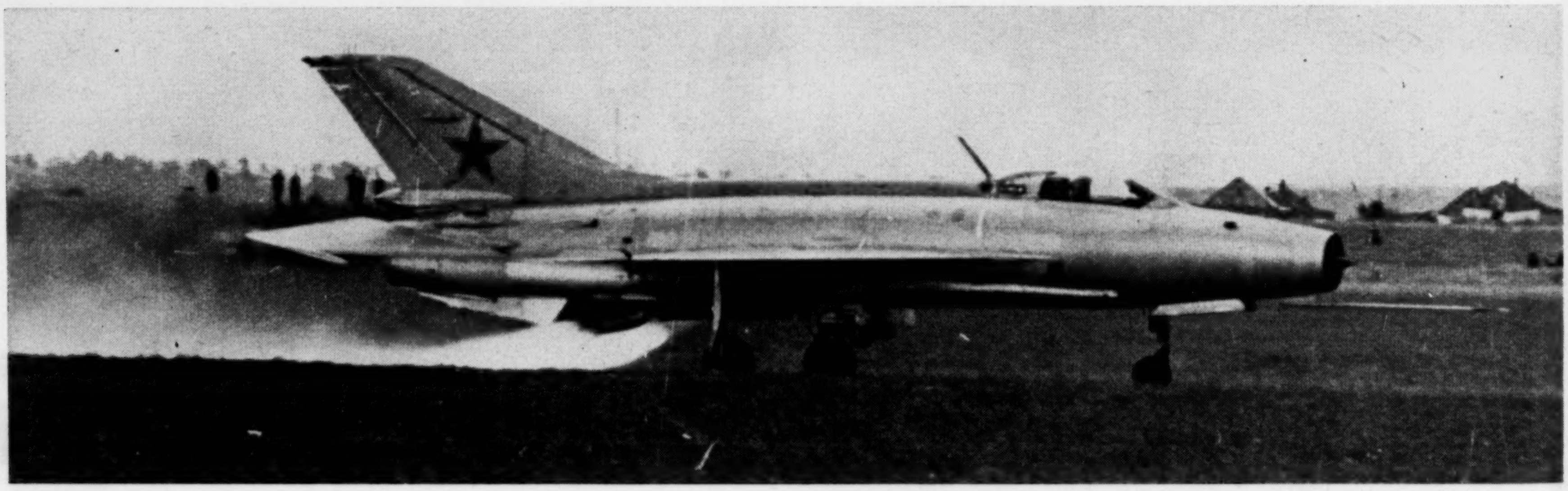
Antonov An-12 drops parachutists in pre-show rehearsal. An-12, described as the military version of the An-10 does not have the auxiliary fins on the stabilizer or the ventral fin of the An-10 and has a modified rear fuselage tail for rear loading and fitting of a tail turret. Parachutists are leaving by a right side door, not rear, however. Both An-10 and An-12 have negative dihedral in the wingtip sections outboard of the engines. India is purchasing An-12s.





Production modifications of the Yakovlev Flashlight C (above) include engine inlet spikes and large bombing radar in the belly. Note lead plane, however, (above) does not have the radome. Earlier Flashlight C (below, left), flown in pre-show rehearsals, has neither spiked inlets nor bombing radar. Flashlight C is an attack version.

Rocket booster used for takeoff from sod field by Mikoyan Fishbed (below) appears to be a shorter unit than one demonstrated at Tushino (above, right). Flame pattern (below) suggests use of two small units instead of single large one at Tushino (AW July 17, p. 27).



## PRODUCTION BRIEFING

**Garrett Corp.'s AiResearch Mfg. Division**, Phoenix, Ariz., has received a $3-million follow-on contract from the Army to produce small gas turbine generator sets for the Sergeant surface-to-surface missile.

**Talley Industries, Mesa, Ariz.,** has completed preliminary development of a solid propellant gas generator to open the Minuteman silo closure prior to missile launch under a $56,000 contract from The Boeing Co. Talley has received an additional $79,000 contract from Boeing for further development and qualification of the unit.

**Weber Aircraft Corp.,** Burbank, Calif., will manufacture "airstairs" and Research Designing Service, Inc., Center Line, Mich., will produce wing spars and chords, wing and body stiffeners, and flood beams for the Boeing 727 under recently awarded contracts.

**Ryan Aeronautical Co.** is supplying U. S. Army with two prototype Model 124-E Firebees, a special configuration of the Q-2C, modified for missions involving the Nike and Hawk missiles, as well as the Redeye infrared-seeking missile used by ground troops against low-flying aircraft.

**Sierracin Corp.,** Burbank, Calif., will supply all-plastic aircraft windshields for advanced turbine-powered Boeing Vertol 107 helicopters. Product of a two-year R & D program, the "Sierracin 900" plastic windshields are heated electrically by a special coating developed by Sierracin.

**Telecomputing Corp.** will supply spring energized subminiature gyroscopes for the Mark 44 torpedo under a $300,000 Navy contract. The gyroscopes will be used for course control during the short interval of time when the torpedo first makes its entry into the water.

**Cessna Aircraft** received a $5-million USAF contract for T-37B twin-jet trainers, for delivery to several foreign countries under U. S. Military Assistance Program auspices. This second export contract on the T-37B extends production of the trainer into mid-1963, with initial deliveries to be made on this order in February, 1962.

**Aerolab Development Co.,** subsidiary of Marshall Industries, Pasadena, Calif., will supply the Argo D-8 four-stage solid propellant rocket vehicle for NASA's Nerv II experiment. Company also will supply engineering support for payload recovery.

**shock problem:**

Supply sensitive, ultra-reliable switchboard instruments for Nike-Zeus control panels. Make them absolutely precise, yet rugged enough to withstand extreme shock. Eliminate the degrading friction of the standard pivot.

**solution:**

Westinghouse furnished Continental Electronics Manufacturing Company, Dallas, Texas, with "Taut Band Suspension" switchboard instruments for the Nike-Zeus control system. "Taut Band Suspension" is a tough metal band about one-tenth the thickness of a human hair. It eliminates conventional pivots and bearings, makes possible an extremely rugged unit with almost infallible repeatability. They bear overloads up to 150 times the full-scale deflection and withstand extreme vibration and shock without influencing accuracy. Appearance is attractive, conducive to quick legibility. If you need this kind of resourcefulness in your current projects, call your Westinghouse sales engineer. Or write: Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pennsylvania. *You can be sure . . . if it's Westinghouse.*

J-92516

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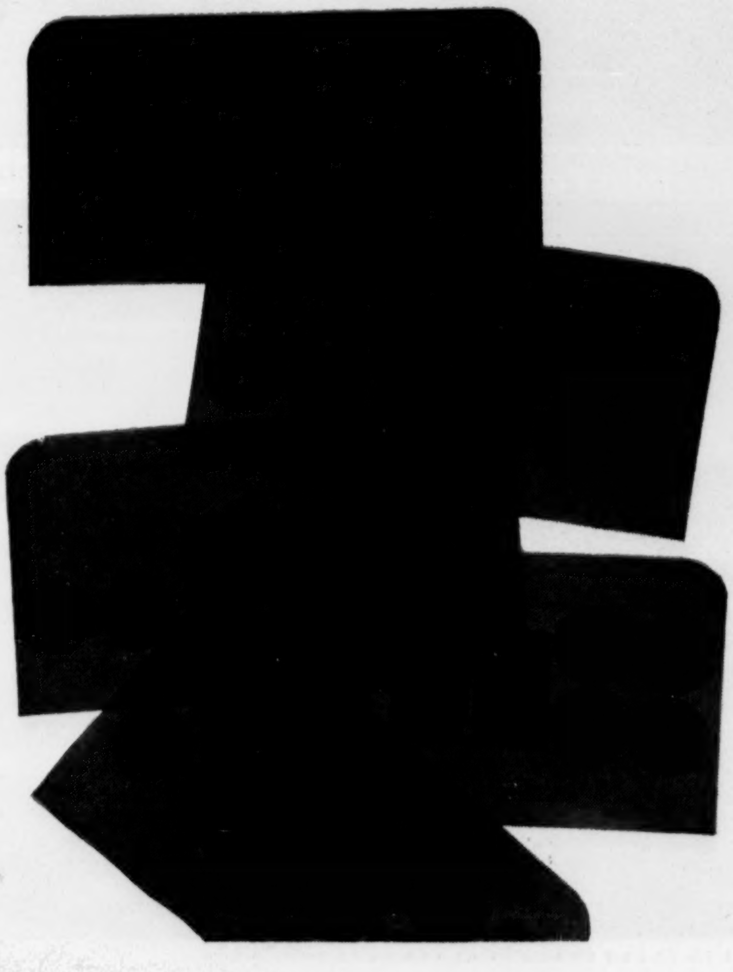
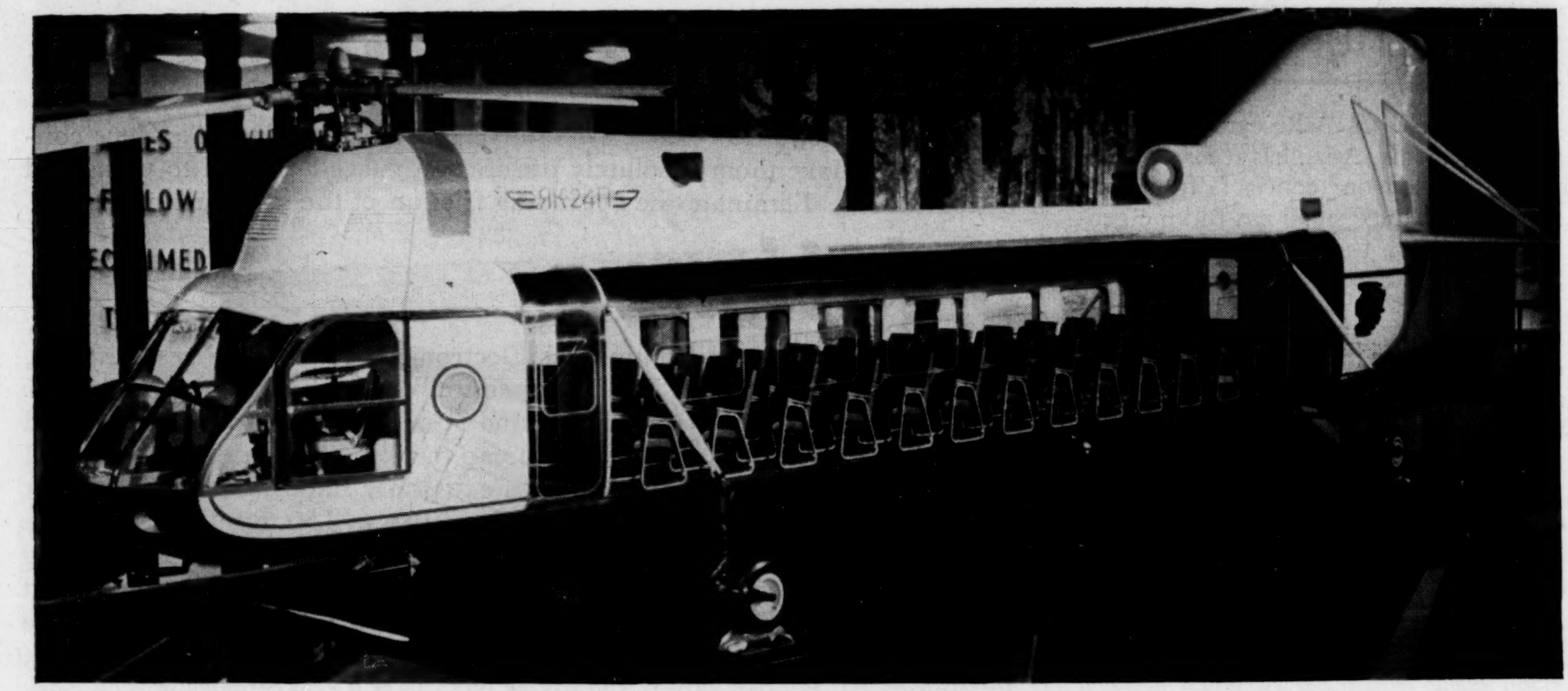
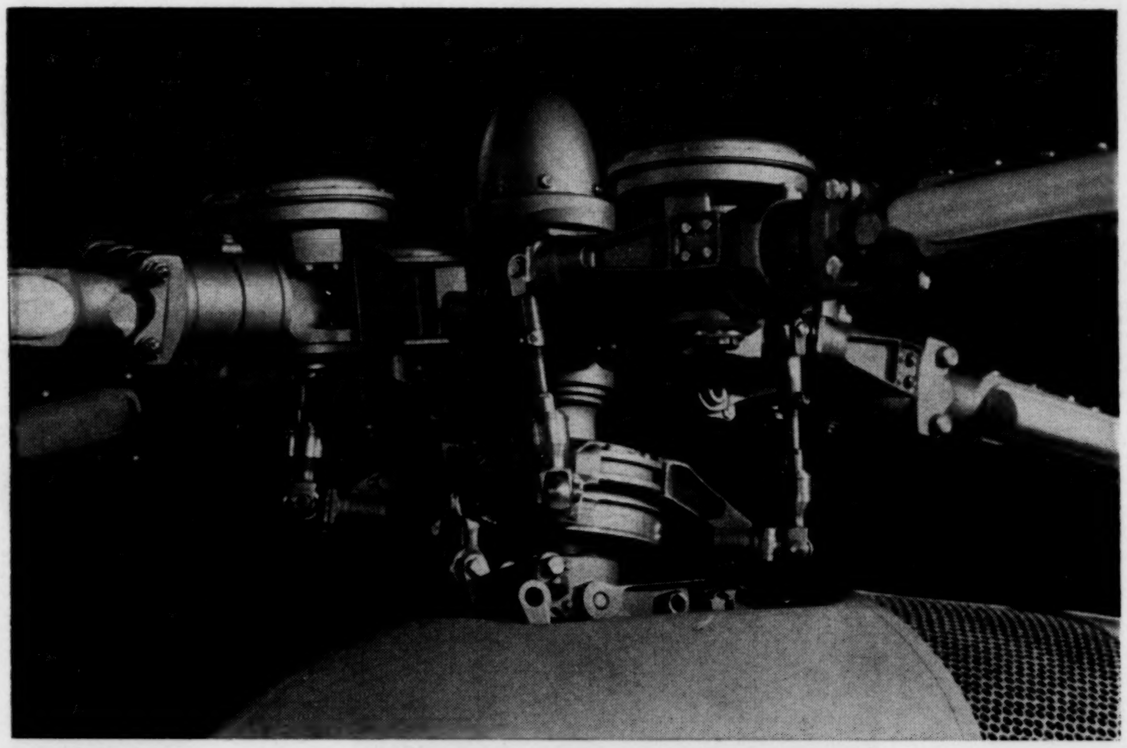


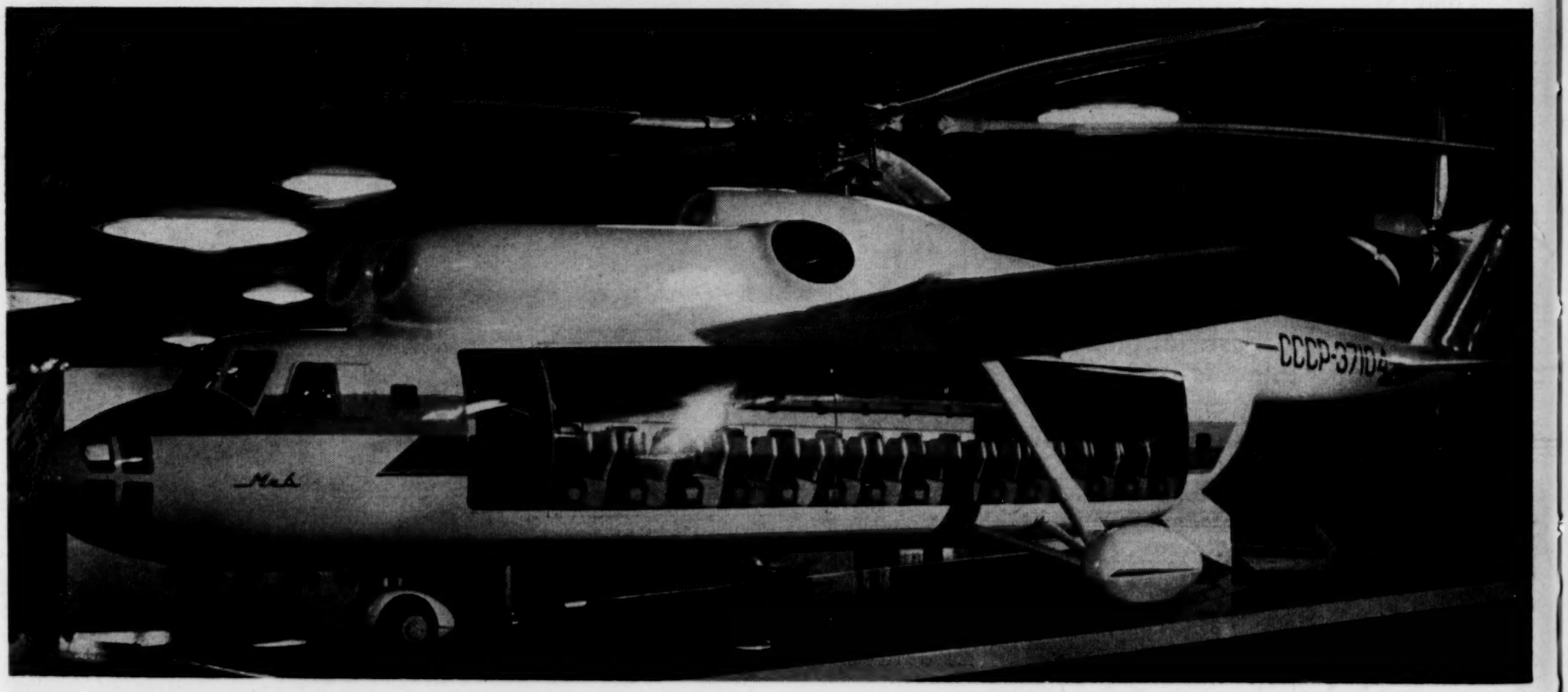


Model of civil twin-turbine Soviet Yak-24P helicopter is displayed at Soviet trade fair in London. Closeup below shows detail of the forward rotor hub on model. Helicopter apparently is a follow-on to the ASh-82 radial-engine-powered nine-passenger Yak-24K.



# Soviets Display Helicopter Models At London Exhibit

Models of Soviet Yak-24P and Mi-6 helicopters in Aeroflot airline markings were exhibited at the Soviet trade fair in London. Yak-24P would carry 39 passengers seated two-abreast on starboard side with single row of seats on port side. Entry is through port door aft of flight deck and via ramp lowered from tail. Soviets say maximum speed is 128 mph., cruise 112 mph., range 185 mi., but were vague about production plans. Mi-6 model (below) would carry 80 passengers in three-abreast and two-abreast seating. Takeoff weight would be 78,000 lb., maximum speed 218 mph., cruise 168 mph. and range 310 mi.



## Sonic Doppler System Marks Descent Rate

**New York**—Precise measurement of rate of descent at touchdown is provided by an airborne ultrasonic doppler system under evaluation at Wright Air Development Division. The system was developed by Gulton Industries, Metuchen, N. J.

Vertical velocity at touchdown is the basic parameter governing flight vehicle structural loads on landing impact—an important criteria in the design of aircraft, helicopters and other VTOL vehicles. Possible future applications for a more powerful, ultrasonic doppler system might be automatic flareout devices for aircraft and soft landing systems for space vehicles.

The Air Force and the Navy have long sought a device for accurate measurement of vertical velocity at touchdown. Methods devised to measure this parameter include mechanical trailing arms, photographic techniques, electronic and electro-optical systems. Success of the systems has varied, with perhaps the most accurate systems involving ground installations.

The Gulton Industries airborne ultrasonic Doppler system measures velocity of the last 18 in. of vertical descent on initial contact and on any subsequent rebounds. Vertical velocity (0 to 20 fps.) is recorded on an airborne recorder.

Three ultrasonic transducer units mounted on the nose and main landing gear bounce a frequency-calibrated signal off the runway reflecting surface and receive the return pulse. The doppler shift resulting as the distance between transceiver and the reflecting surfaces changes is a function of closure rate. The detected frequency is then tracked to produce a d.c. voltage proportional to the detected frequency.

The transmitter utilizes an 80-kc. crystal. This 80-kc. unmodulated signal is fed to the ceramic transducer element which consists of a cluster of Bender elements tuned to approximately 80 kc. The single element receiving units obtain a sound intensity of 110 db. for a transmit reflect path of 72 in. The output of the receiver is mixed with a 74-kc. frequency and provides an output frequency of 6 kc. at zero doppler. The received signal will vary from 80 to 83 kc. as the vertical velocity changes from 0 to 20 fps.

Air temperature effects on sonic velocity necessitate a temperature control. This is afforded by a velocity correction channel which sends a modulated pulse across a precise 6.6-in. distance to a receiving transducer. The circuit is designed so that pulse width is determined by the transmission time (approximately 500 microseconds). This is

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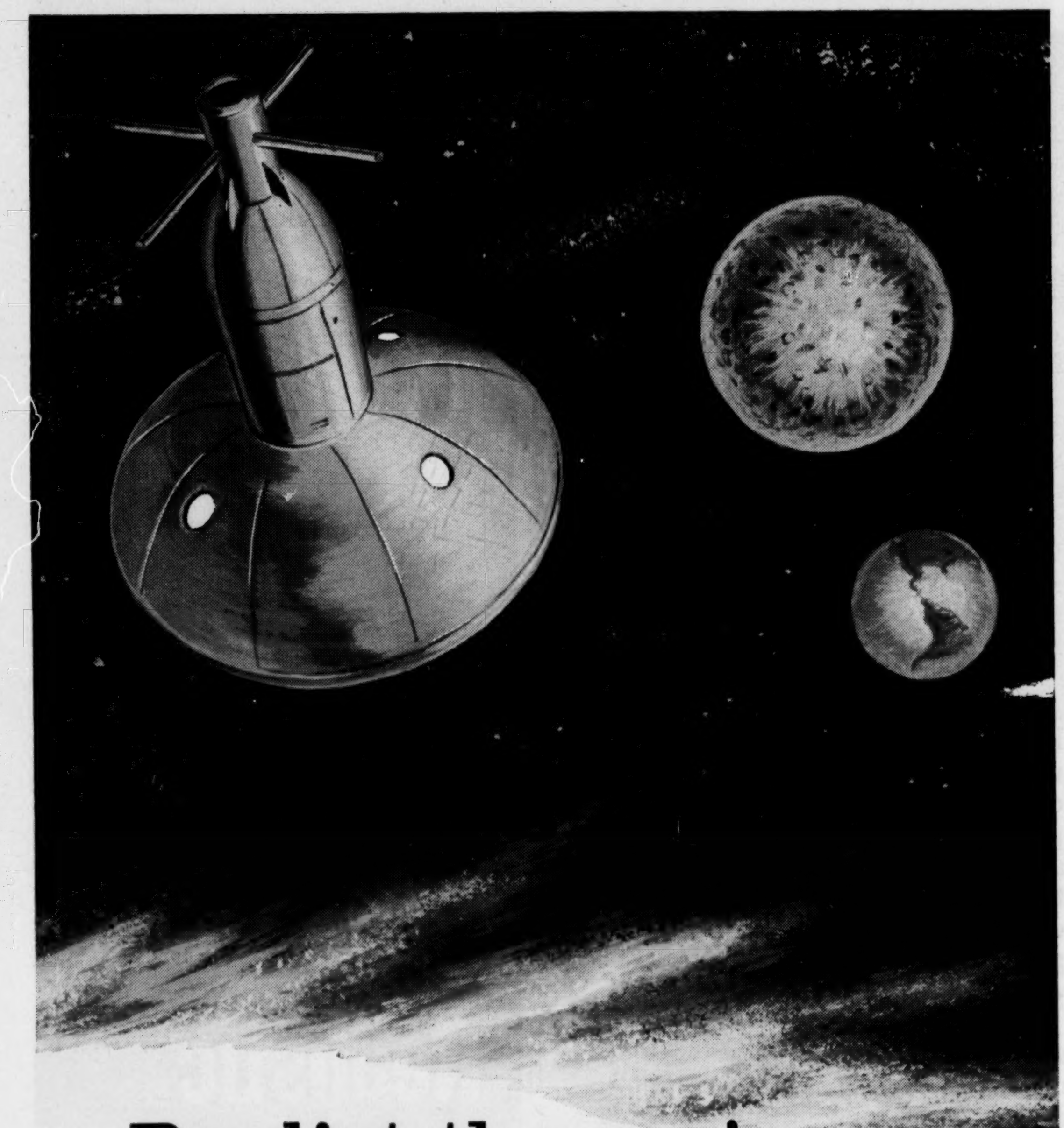

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used to feed correction circuits in each receiver channel, thus providing temperature control.

Atmospheric conditions which would appear to affect the accuracy of the ultrasonic doppler include a boundary heat layer near the ground and wind conditions. Gulton says that company tests performed on a sunny August day over concrete, black asphalt and metal rail surfaces indicate less than 10C temperature differential maximum over the last 3 in. of travel. Thus, with the transducers mounted 18 in. from the bottom of the wheel, the error is endured over 1/6 of the total path. This is computed to be 0.3% maximum.

The effect of wind conditions on sonic velocity is negated by mounting the sending and receiving transducers adjacent to one another so that the forward and return paths are acted upon equally.

Aircraft forward velocity may vary from 0 to 400 fps. so beam width on the ground is 14-in. wide to ensure reception by the receiving transducer. At 400 fps. forward velocity (275 mph.) an aircraft will travel about 2.4 ft. in the time required for the sound to make a 6-ft. round trip.

The Gulton rate-of-descent indicator system consists of six component units: a power supply unit, a doppler transmitter velocity correction unit, doppler receiver and three transducer units. The power supply is a transistorized unit which will operate from a 28-v.d.c. or 115-v. 400-cps. source. The doppler transmitter-velocity correction unit contains two silicon semiconductor transistorized subsystems. The doppler receiver consists of three separate receiver channels and is electronically similar to the doppler transmitter unit.

Each of the three transducer units consists of a transmitting and receiving transducer for sensing landing velocities.

## Shatterproof Wheels Prove Out on Hustler

**Ft. Worth, Tex.**—Shatterproof auxiliary wheels have been successfully tested on the General Dynamics/Ft. Worth B-58A Hustler supersonic bomber at Edwards AFB, Calif. The new aluminum alloy wheels, 15 in. in diameter, are mounted between each pair of 22-in. B-58 tires.

In the tests, tires were blown by firing spikes into them after the B-58 had rolled 1,500 ft. and was at full power. After the intentional blowout, the B-58 continued to accelerate down the runway for 10,000 ft., taking off at 258 mph. and then landing at 160 mph., rolling on the shatterproof auxiliary wheels for 13,000 ft. The new nonfrangible safety wheels are made by Goodyear Tire & Rubber Co., Akron.

# MISSILE ENGINEERING

**RAMJET-POWERED** AG-32 meteorological sounding rocket is produced by Anderson, Greenwood & Co. Left photo shows rocket booster.

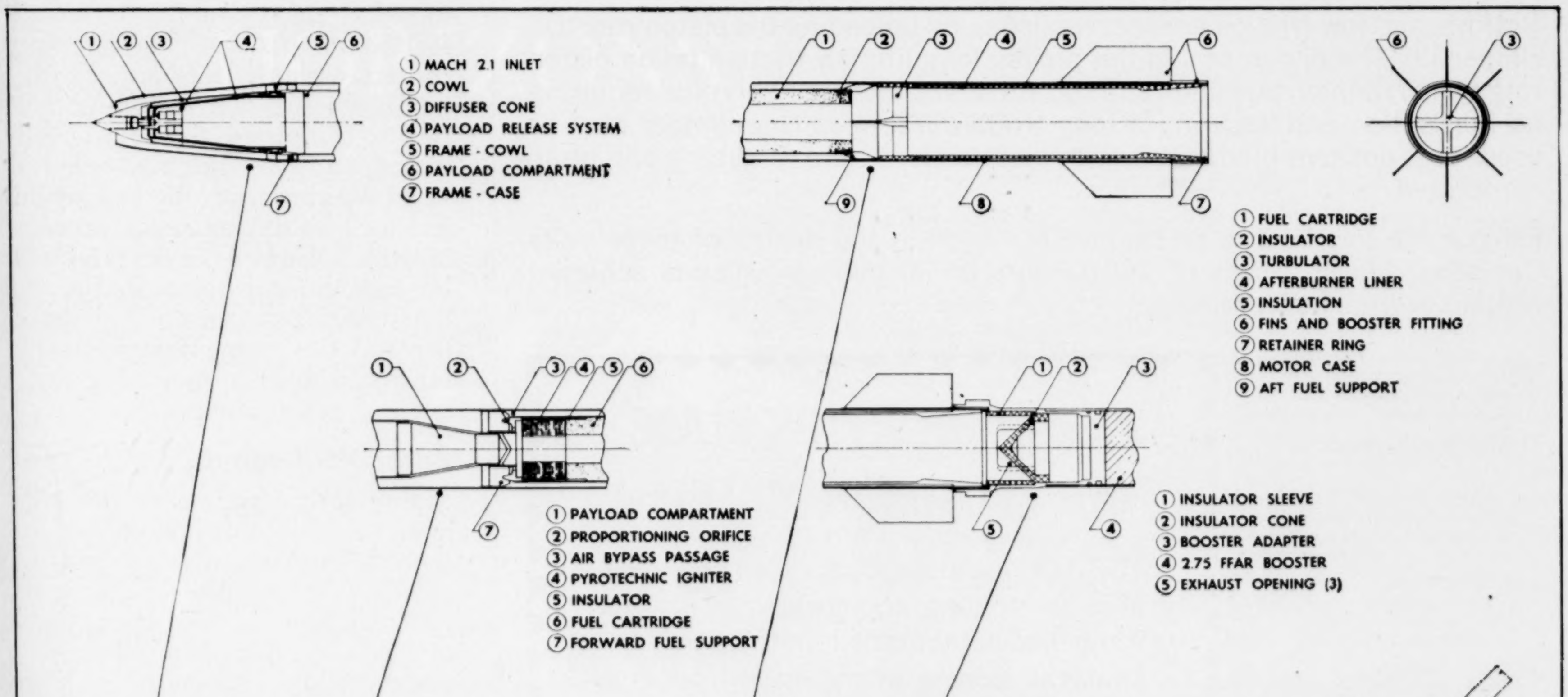
# Light Rocket Features Solid-Fuel Ramjet

By Erwin J. Bulban

**Dallas, Tex.**—Solid-fueled ramjet-powered meteorological sounding rocket has been tested successfully to its design altitude of 200,000 ft.

The probe, capable of carrying a scientific payload of up to 1.5 lb., was designed and built by Anderson, Greenwood & Co., Houston, Tex. The company hopes it will find application by research groups and a continental meteorological rocket network for gathering data from 100,000 to 200,000 ft. on a low unit cost. Because the vehicle is built around readily available rocket stages, cost of complete units, minus payloads, is estimated at $400 each in quantity, based on a production rate of 100 per month.

Basically, the AG-32 Met Jet is a


① MACH 2.1 INLET
② COWL
③ DIFFUSER CONE
④ PAYLOAD RELEASE SYSTEM
⑤ FRAME - COWL
⑥ PAYLOAD COMPARTMENT
⑦ FRAME - CASE
① FUEL CARTRIDGE
② INSULATOR
③ TURBULATOR
④ AFTERBURNER LINER
⑤ INSULATION
⑥ FINS AND BOOSTER FITTING
⑦ RETAINER RING
⑧ MOTOR CASE
⑨ AFT FUEL SUPPORT
① PAYLOAD COMPARTMENT
② PROPORTIONING ORIFICE
③ AIR BYPASS PASSAGE
④ PYROTECHNIC IGNITER
⑤ INSULATOR
⑥ FUEL CARTRIDGE
⑦ FORWARD FUEL SUPPORT
① INSULATOR SLEEVE
② INSULATOR CONE
③ BOOSTER ADAPTER
④ 2.75 FFAR BOOSTER
⑤ EXHAUST OPENING (3)
2.75
98.50

**MET JET** ramjet design details. Solid-fuel grain is magnesium and magnesium-aluminum alloy epoxy-metal charge.

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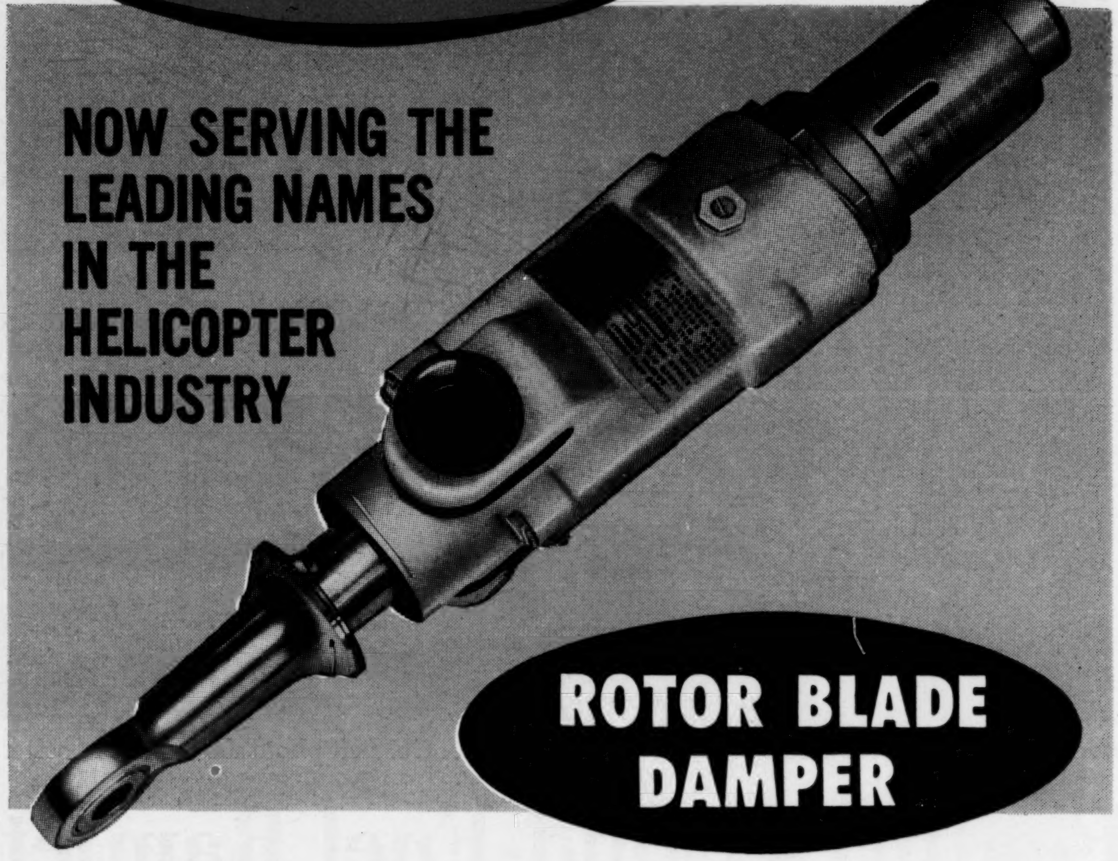
**AERO PRODUCTS, INC.**



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Seal life and low friction are accomplished by unloading the piston rod "O" ring seals. The piston seal is the proven long life low friction teflon piston ring pair. Trunnion bushings and rod end ball joints are "Fabroid" requiring no lubrication and assuring a long trouble free life. The damper may be used as a positive blade stop in both directions, and snubbing can be incorporated.

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21-lb. rocket, 98.5 in. long and 2.75 i
in diameter, the latter being the dime
sion of a standard folding fin aircra
rocket (FFAR) produced in large qua
tities for tactical air-to-air use. Th
rocket produces 730 lb. thrust for 1
sec. which accelerates the second sta
to 2,000 fps. velocity necessary for ra
jet engine operation. After separatio
the ramjet sustains or slightly increas
velocity through the denser portion
the earth's atmosphere until fuel
expended after some 30 sec. at an alt
tude of 70,000 ft. After ramjet burnou
the vehicle coasts the rest of the wa
to design apogee.

## Propellant Grain

The solid-fuel grain of the Met J
is a magnesium and magnesium-alum
num alloy epoxy-metal charge with
combustion temperature of appro
mately 4,750 deg. Since it does n
contain an oxidizer, the fire hazard
minor—fuel ignition must be acco
plished by a high heat source such
a magnesium flare.

Operationally, the rocket booster pr
vides acceleration beyond the ram
stage's Mach 1.6 minimum speed. A
passes over the 25-deg. cone and
supersonically diffused to Mach 1 at t
cowl's inlet lip. All internal diffusi
is subsonic and takes place in the ri
passage around the payload "islan
and adjacent to the outside skin. T
pressure attained determines the ma
mum pressure at which fuel combusti
can take place.

Compressed air then passes a pr
portioning orifice, which routes 85
of the air down a passage outside t
solid-fuel sleeve and 15% through t
fuel center passage. The air charge
contact with the fuel burns with it
produce a fuel-rich gas whose combu
tion is completed as the originally b
passed air joins the fuel-rich hot g
in an afterburner section. Combusti
is aided by a mixing device called a Tu
bulator. Burned gases are forc
through the exit nozzle by the pressu
differential between combustion cha
ber and the ambient atmosphere, th
expansion further increasing exit ve
city and thrust energy.

## Ramjet's Regime

The special regime of the solid-fu
ramjet is in intermediate ranges at hi
speed. The currently achieved net i
pulse of 700 lb. per sec. per pound
fuel may be capable of being develop
to 1,200 lb., Anderson, Greenwood e
gineers believe, compared with appro
imately 180 to 240 for solid rocke
and thus providing greater range p
pound of fuel than a conventional sol
rocket, they add.

AG engineers note that since t
ramjet is an air breather, it is normal
not conceived as capable of high-al

A compelling challenge — to assist the orthopedically handicapped in performing the simple and rewarding manual functions that lead to richer, more useful lives.

Working with orthotic and prosthetic specialists in hospitals and medical schools, Fairchild Research and Development personnel have done considerable experimentation in this field with strain gauges, special assemblies and Micrologic components. Using these elements as sensing, logic, control, and feedback building blocks, it is thought that human mechanisms for commanding and verifying body motions may be closely approximated.

Problems are myriad. The challenge great. The rewards immeasurable. We believe it a worthy goal to unlock doors in the Human Horizon. If you would like to share in a challenge such as this, and yours is a relevant background, we would like very much to hear from you.

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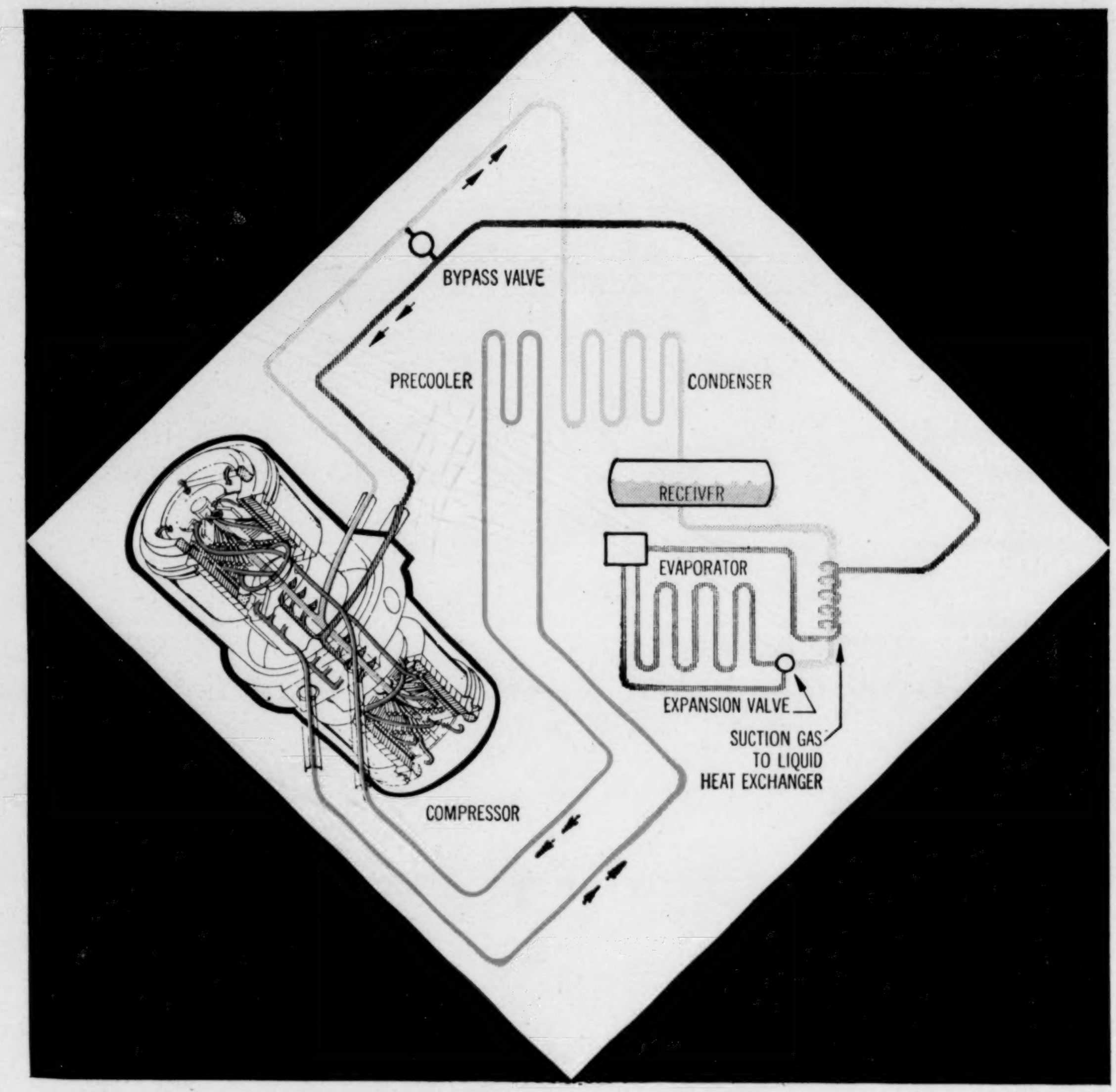

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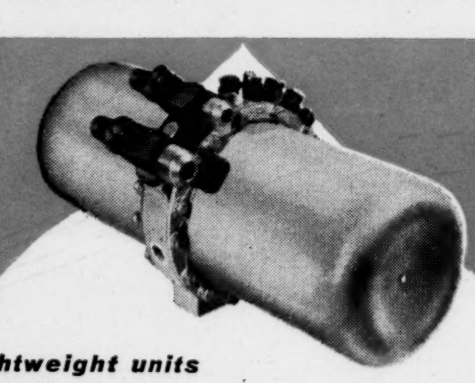


tude operations, but indications are that this type powerplant appears capable of producing thrust to approximately 100,000 ft., and final velocity at burnout could provide a peak coast altitude of some 500,000 ft.

The Met Jet development has resulted in hardware rounds being purchased by the U. S. Army Signal Missile Support Agency, White Sands, which has recently fired it successfully, and also by the Navy's meteorological group at the Pacific Missile Range in connection with its studies on a continental meteorological rocket network. Three rounds have been fired by the former group and 18 by the latter.

### Weight Control

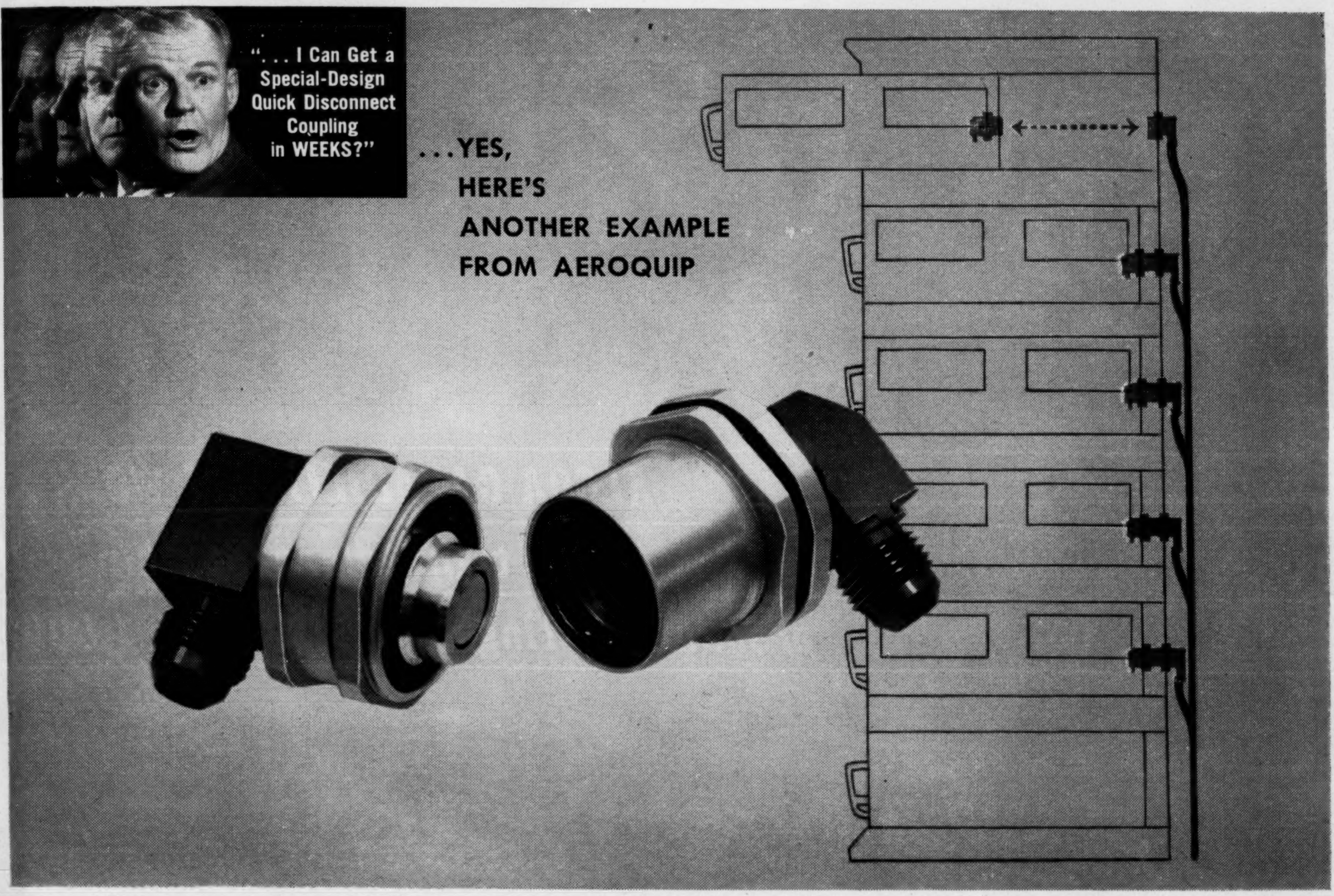
One of the problems of designing a 20-lb. vehicle which travels approximately 40 mi. upwards carrying a 1.5-lb. payload is weight control. The tube wall of the 2.75-in. outside diameter ramjet is 0.01 in. Inconel X material, the inlet cone and cowl are 304 stainless steel as are their spotwelded support frames. The payload island is primarily 0.008 stainless steel and HM31A thorium magnesium. The fuel support tube is magnesium, as is its forward support ring and the proportioning orifice. The aft fuel support ring is 4130 steel. Thermal insulators in the fuel tube are high-temperature-resistant plastics. The combustion chamber, Turbulator and nozzle are graphite-insulated from the outer motor tube by a 0.04 thickness of trowled-in-place Flameastic. The eight fins are a single piece of aluminum, which also comprises the booster fitting. The booster adaptor is machined magnesium casting with asbestos-filled plastic flame deflector and wall protector cemented in place. Three ports in the booster adaptor permit escape of ramjet gases during the boost phase.

Launch is simply carried out from a Loki rocket tube, with the folding fins held in place by a split nylon ring which provides one point of support for launch. The second support point is on the booster adaptor fitting which also rides the rifling rails in the launch tube and imparts a slow rotation to the rocket to reduce dispersion.

## Grand Central Tests New Solid Propellant

**Redlands, Calif.**—Test firings of a new solid propellant called Polycarbutene-R, designed for high combustion efficiency at low chamber pressures, have begun at Grand Central Rocket Co.

Grand Central is proposing that the new propellant be used in the upper stages of multi-million pound thrust, multi-stage spacecraft boosters. Test firings have been run at chamber pres-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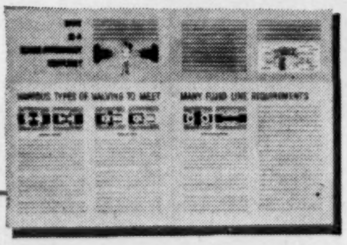

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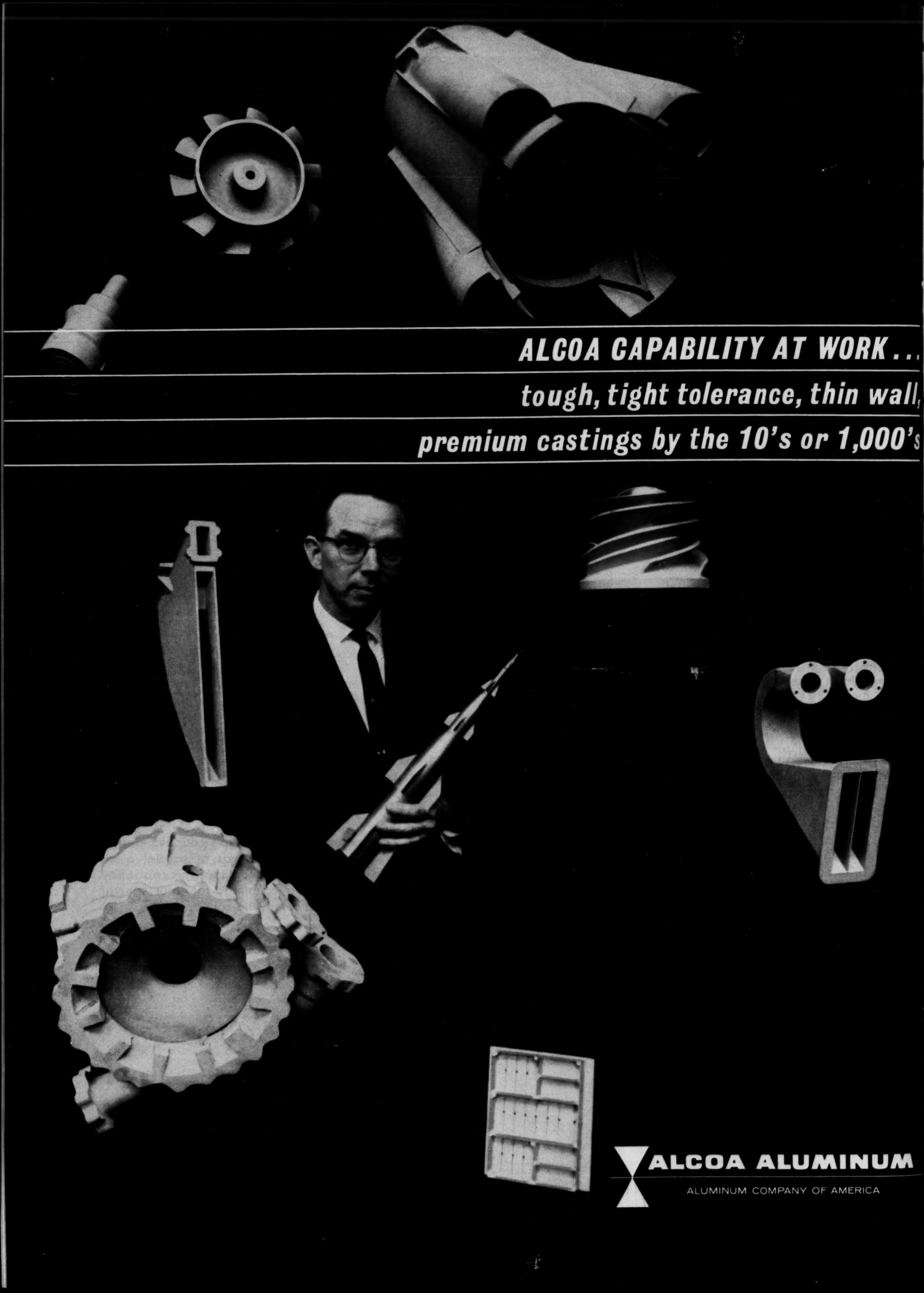
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sures below 200 psi. Solid propellant rocket chamber tests ordinarily range from 500 psi. to 1,200 psi. Lower chamber pressures will enable designers to use lighter motor cases to get higher propellant mass ratios and better performance.

The company has fired more than 30 test motors, each containing 50 lb. of Polycarbutene-R with substantial loadings of aluminum powder. Polycarbutene-R is called "a production-type liquid polymer of butadiene and acrylic acid combined with advanced curing agents." The test motors were qualified for a temperature range between −100F and 180F.

Soon, Grand Central plans to test-fire a pair of 3-ft.-diameter, segmented motors each containing more than 5,000 lb. of the new propellant and another pair loaded with about 8,000 lb. of propellant. They will be ignited at widely differing temperatures. The new propellant is used with a special liner qualified between −110F and 220F.

## Sud Develops Family Of Sounding Probes

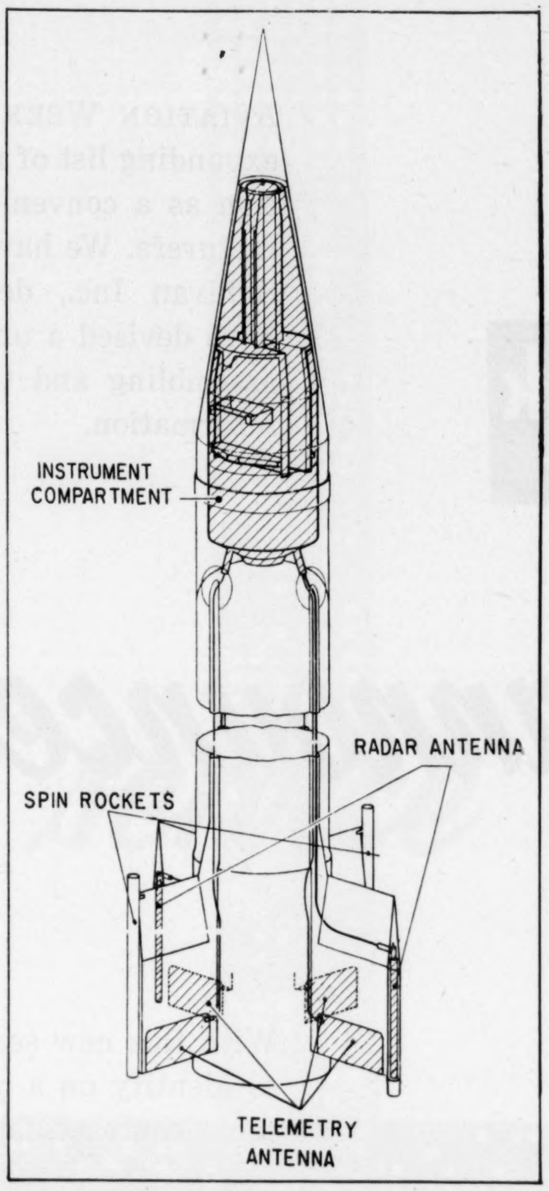
**Paris**—Sud Aviation is developing a series of inexpensive high-altitude sounding rockets designed eventually to lift 660-lb. payloads up to altitudes of 100 mi.

Sud already has test-fired two early types with complete success. Rockets are being built by Sud for the Centre National d'Etudes des Telecommunications, research branch of the French Post Office.

The series of six different types was designed to supply government scientists with a cheap yet reliable sounding rocket. All six rockets are powered by solid fuel.

The six rockets break down into two groups. First group includes the following four rockets:

- **Belier.** Single stage, Mach 4.8 rocket designed to lift 40-lb. payload to 50-mi. altitude. Costing about $6,000 per unit, two Beliers were fired in the Sahara late in May.
- **Centaure.** Belier as upper stage fitted with first stage booster. Mach 5.5 rocket designed to lift 40-lb. payload to 110-mi. altitude. Costing about $10,000, two Centaures were fired in the Sahara late in May.
- **Dragon.** Again, Belier is used as upper stage. To this is fitted a booster stage delivering some seven tons of thrust. Rocket reaches Mach 7.5 and carries 40-lb. payload to 250-mi. altitude. Dragon units are scheduled to be ready by spring, 1962.
- **Pegase.** Belier upper stage fitted atop two-stage booster. Pegase, reaching Mach 12.5 speeds, will carry 40-lb. payload up to 620-mi. altitude. Pegase is expected to be fired in spring, 1962.



**STANDARD LAYOUT** of the Belier rocket family shows sealed instrument compartment linked with thrust unit by wire along side of rocket case. Spin rockets fire immediately after liftoff, then disengage.

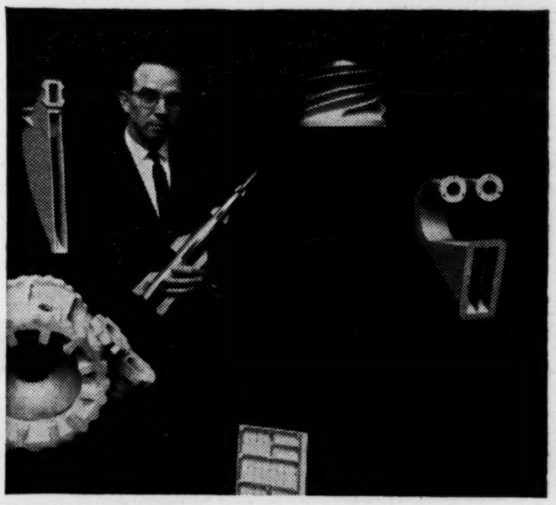
All four of these sounding rockets are non-guided. Small jets fitted onto the tail surfaces spin the rockets immediately upon launching and then disengage.

Ground control is limited to destruction. Tracking is achieved by radar signals received and retransmitted by special units fitted into the rocket's tail unit.

Four antennas—in addition to the radar transmitters—are fitted into the trailing edge of the tail surfaces. These handle telemetering chores.

In addition to these four sounding rockets, all centered around the Belier, Sud is developing two larger rockets for high-altitude probes. These rockets, slated to be ready for launching next spring are:

- **Aigle.** Single stage rocket containing 1,320-lb. booster charge will lift 220-lb. payload to 120-mi. altitude or 660-lb. payload to 55 mi.
- **Eridan.** Same as Aigle except booster is hooked on as first stage. Eridan will lift 220-lb. payload to 220-mi. altitude or 660-lb. payload to 100-mi. heights.



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**Aviation Week**
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AVIATION WEEK and Space Technology's ever-expanding list of marketing services has a new addition as a convenience to aerospace industry manufacturers. We have engaged the services of Frost & Sullivan Inc., defense marketing specialists who have devised a unique data processing program for assembling and tabulating defense contract award information.

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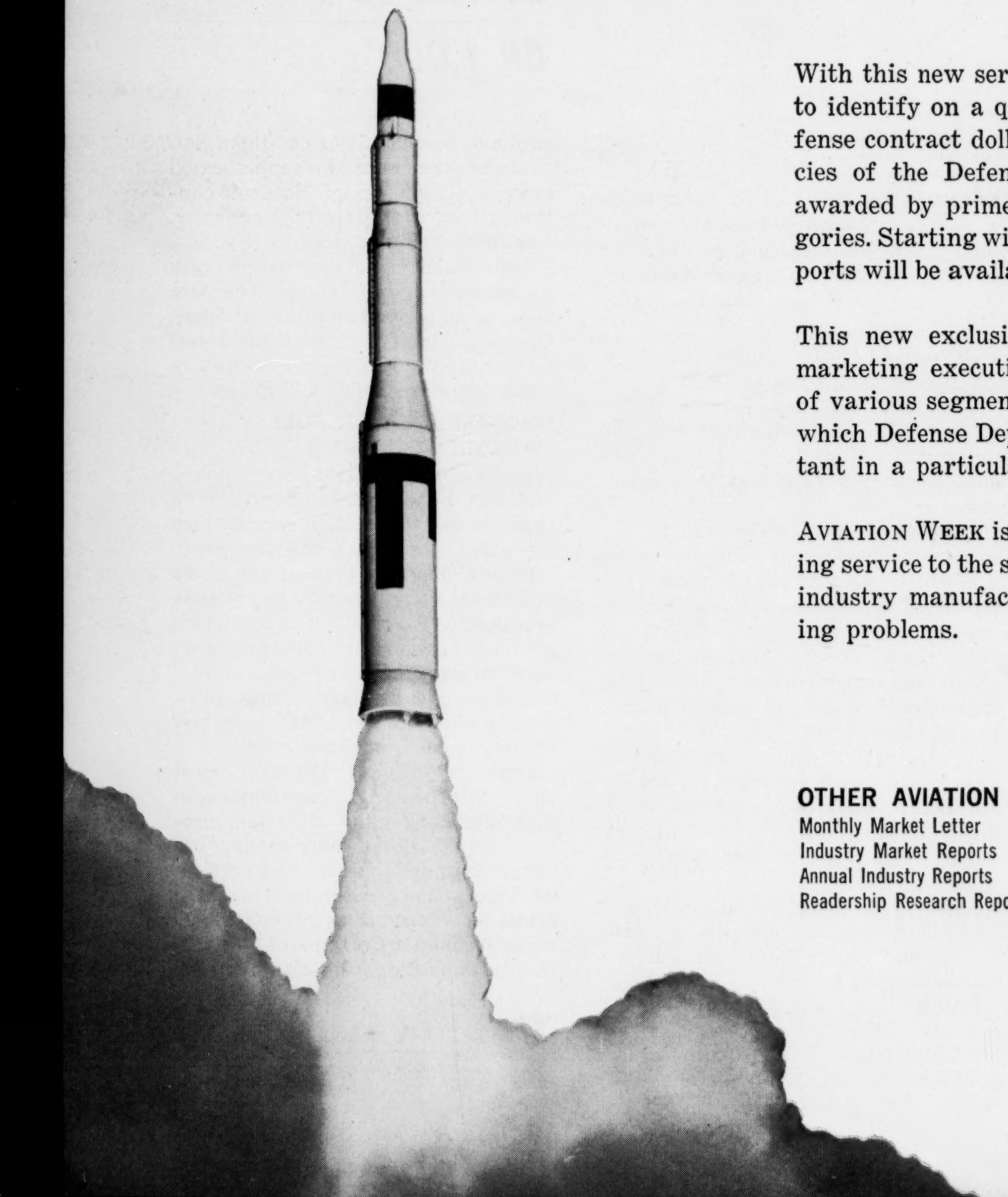

With this new service, AVIATION WEEK will be able to identify on a quarterly basis the total prime defense contract dollars awarded by the various agencies of the Defense Department and subcontracts awarded by prime contractors in 175 product categories. Starting with the 4th fiscal quarter of 1961, reports will be available on an individual request basis.

This new exclusive service will enable aerospace marketing executives to determine the importance of various segments of the industry and to discover which Defense Department agencies are most important in a particular product/system category.

AVIATION WEEK is pleased to add this unique marketing service to the services it now renders to aerospace industry manufacturers on their sales and marketing problems.

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Frost & Sullivan are defense marketing specialists who have spent over two years developing and proving a method to gather and analyze information on defense contract awards. Statistical computations show their data processing service with a capability of identifying over 90% of all prime defense contract awards over $50,000 and a significantly high percentage of subcontracts awarded by prime contractors.

Unlike other contract reporting systems which simply report on individual contracts awarded, the Frost & Sullivan service has tremendous flexibility because all information is computer processed. Practically any combination of summary information is readily available on a special request basis from Frost & Sullivan. For example the regular quarterly reporting service includes a product and company series.

The product series shows which companies received contracts in 175 product/system categories. The company series analyzes individual companies by contracts received.

Naturally, in order not to conflict with the aims of Frost & Sullivan, AVIATION WEEK is restricted in the amount of information it can provide free. Companies interested in further information on Frost & Sullivan services, are invited to contact them direct.

**Frost & Sullivan Inc., 170 Broadway, New York 38, N. Y.**

**Aviation Week**

**and *Space Technology***

**A McGraw-Hill Publication**

330 West 42nd Street, New York 36, N. Y.

Titan II unit shown in Hamilton Standard White Room for assembly and checkout. Unit is designed to pump and meter propellants to first and second missile stages at rates up to 190 gpm and pressures to 150 psig.

# White room for the Titan II propellant transfer system

Development and production of equipment for handling extremely volatile missile fuels—like the propellant transfer unit for The Martin Company's Titan II—demands a contamination-free environment, controlled to within 0.3 microns. Hamilton Standard's new White Room, especially designed for building missile fuel handling systems, even surpasses the exacting requirements of a hospital operating room. It provides 900 square feet of ultra-modern assembly and testing equipment. Detailed construction care and strict control procedures will maintain immaculate conditions . . . always.

Building a propellant transfer unit for the Air Force Titan II missile program is just one of several recent GSE projects in which extreme cleanliness has been a major consideration. This package unit is skid-mounted, electrically powered, manually controlled (with automatic safeties), and capable of pumping either fuel or oxidizer. Performance is measured by its ability to absolutely contain toxic fluids and vapors. To meet these requirements, Hamilton Standard developed important new concepts in sealing and system reliability.

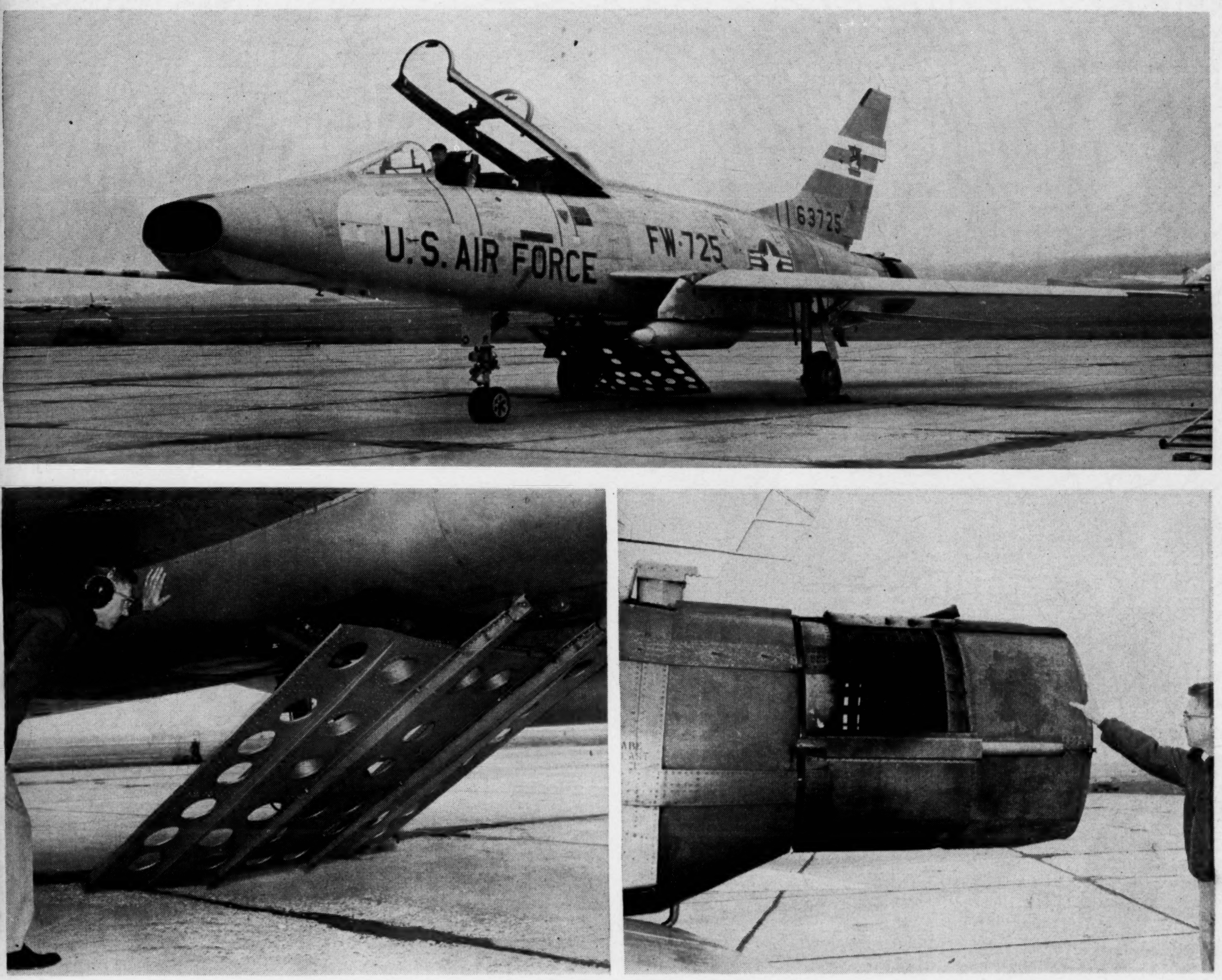
The White Room's capabilities work hand in hand with other key controls to provide manufacturing quality, functional reliability, low system cost, and on-time delivery of all Hamilton Standard Ground Support Equipment.

For the solution to your missile fuel handling problems . . . or any GSE assignment from miniature components to complete weapon support systems, phone: Manager, Ground Support Equipment Department, Hamilton Standard, Windsor Locks, Connecticut; or write for illustrated brochure.

**UNITED AIRCRAFT CORPORATION**

**HAMILTON STANDARD DIVISION**

**GROUND SUPPORT EQUIPMENT**



## Drag-Increasing Device Has Dyna-Soar, X-15 Application

**North American F-100 Super Sabre fighter has been modified by the Air Force Aeronautical Systems Division with devices to increase drag in order that steep angle landings can be made to test the possibility of eliminating long runways needed for the unpowered landings of the X-15 and the Dyna-Soar boost-glide vehicle. Afterburner and drag chute have been removed and replaced with a thrust reverser and the regular drag brake of 12 sq. ft. has been replaced with one of 33 sq. ft. Landing profile includes operating the thrust reverser at 6,000 ft., making a steep angle approach and landing at 230 mph. instead of the normal 155 mph. Tests are expected to reveal whether manual or autopilot control will be best for steep landings.**

# USAF Contracts

Following is a list of unclassified contracts for $25,000 and over as released by U. S. Air Force contracting offices:

**HEADQUARTERS, ROME AIR MATERIEL AREA, USAF, Griffiss AFB, N. Y.**

**Collins Radio Co.,** Cedar Rapids, Iowa, WKM-2A portable transceiver. Contract AF 30(635)23986, $25,122.

**Canadian Commercial Corp.,** Ontario, Canada. Telephone cable iaw MIL-C-3150B and MIL-C-3458A. Contract AF 30(635)23220, $188,818.

**RCA Service Co.,** Camden 8, N. J. Installation of outside plant facilities for AIRCOM transmitter and receiver sets at Moron and San Pablo, Spain, $62,669. Order to Contract AF 30(635)21592.

**The Dominion Road Machinery Co.,** Goderich, Ontario, Canada. Misc. parts for Dominion Road Grader Model D-562-C. Contract AF 30(635)20438, $28,235.

**Canadian Commercial Corp.,** Ottawa, Ontario, Canada. Telephone cable. Contract AF 30(635)20469, $27,730.

**Hatfield Wire & Cable Div.,** Hillside, N. J. Power cable iaw MIL-C-3432B. Contract AF 30(635)23041, $38,489.

**D. S. Kennedy Co.,** Cohasset, Mass. Reflector Type 692 and complete with feed support assembly. Contract AF 30(635)23691, $26,564.

**Defense Electronic Products,** Camden, N. J. In plant rework & modification of 5 ea. AN/GSA-28-pre-launch-translator groups. Amend to Contract AF 30(635)19355, $62,500.

**Collins Radio Co.,** Cedar Rapids, Iowa. Spare parts for KWT-6-5 AF 30(635)24137, $55,404.

**Canadian Commercial Corp.,** Ottawa, Ontario, Canada. Engineering and installation of C-E equipment including ground-to-air transmitter receiver (GATR) facilities and AN/FPS-26, AN/FPS-7, AN/UPX-14, AN/UPA-35, at USAF sites located in Canada. Order to Contract AF 30(635)17273, $1,252,780.

**Eastman Kodak Co.,** Rochester, N. Y. Film, motion picture. Order to Contract AF 30(635)18904, $43,235.

**Radio Corp. of America,** Camden, N. J. QRC-161 receiving system. Contract AF 30(635)23511, $1,578,842.

**Space Technology Laboratories,** Canoga Park, Calif. QRC-152A (T) ground readout equipment. AF 30(635)22030, $66,000.

**Canadian Commercial Corp.,** Ottawa, Ontario, Canada. Cable telephone iaw MIL-003458, 85,000 ft. Contract AF 30-(635)23246, $58,370.

**International Business Machines Corp.,** Rockville, Md. Incorporation of ECP 10262 and ECM 3015 into AN/FSQ-7 and AN/FSQ-8 Sage computers. Contract AF 30-(635)3130, Call No. 66 to order, $129,348.

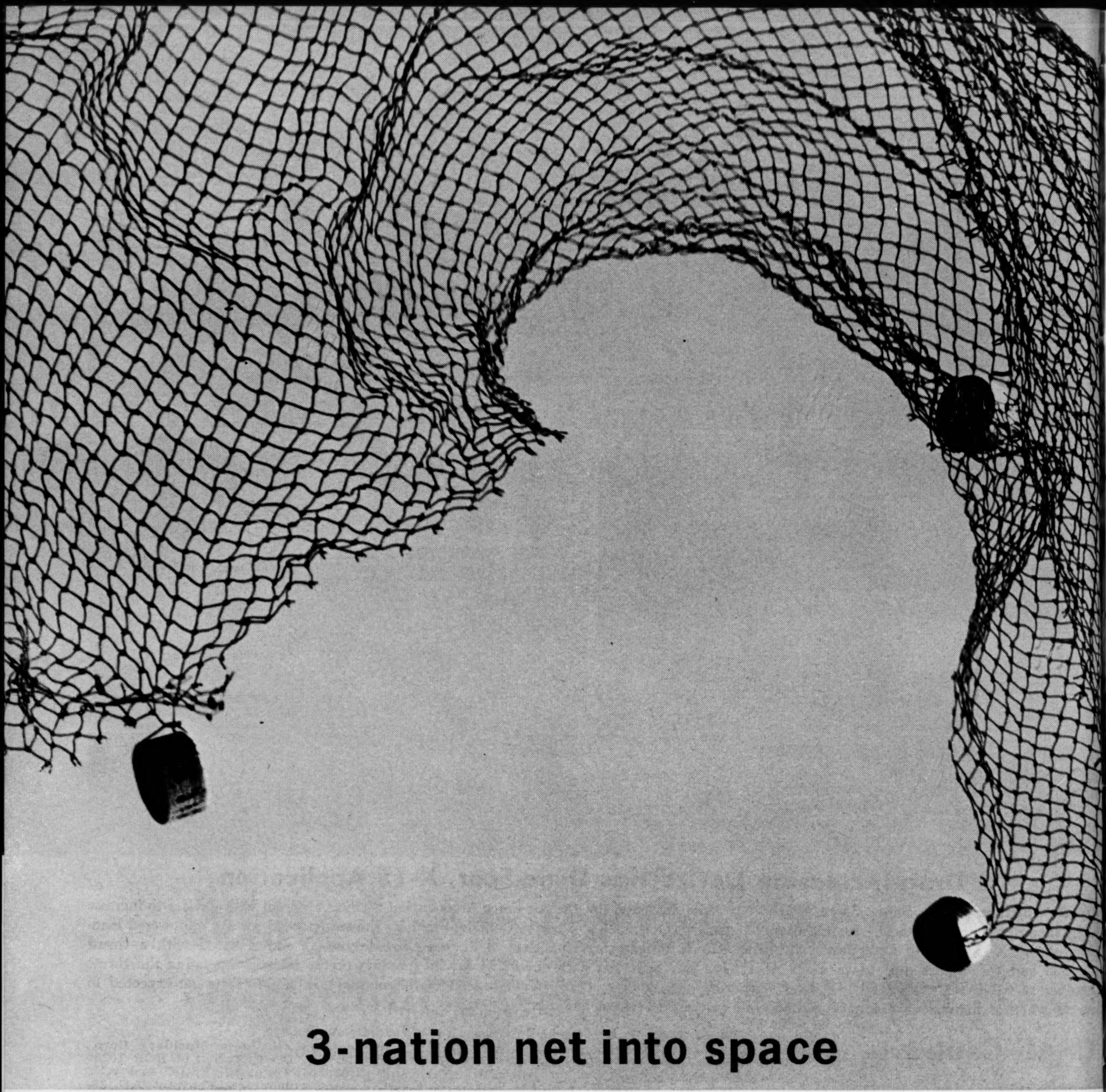
**Collins Radio Co.,** Cedar Rapids, Iowa. Depot level maintenance and supply support services for electronics equipment contained in six Project High Ball mobile vans. Order to Contract AF 30(635)21152, $25,000.

**HEADQUARTERS, ELECTRONIC SYSTEMS DIVISION, USAF, Laurence G. Hanscom Field, Bedford, Mass.**

**Itek Corp.,** Waltham, Mass., studies on and development of techniques for scientific information, job (RFP 93576 & 93576A), AF 19-(604)-8438, awarded May 10, 1961, $96,088.

**Research Laboratory, General Electric Co.,** Schenectady, N. Y., research and development of a thermionic energy converter to permit conversion of thermal energy to electrical power, job (RFP 129295), AF 19-(604)-8424, awarded May 9, 1961, $94,950.

**Research Foundation, Lowell Technological Institute,** Lowell, Mass., Research directed toward determining absolute line intensities of atoms and molecules by means of a shock tube, job (FRP 160979), AF 19-(604-8481), awarded May 9, 1961, $30,000.



# 3-nation net into space

Goldstone, Calif., Woomera, Australia. Krugersdorp, South Africa.

Three different parts of the world thousands of miles from each other. Yet drawn together in a new and unique communications net: the Deep Space Instrumentation Facility.

DSIF is under the technical direction of Cal Tech's Jet Propulsion Laboratory for the National Aeronautics and Space Administration. Staffed and run by the host countries, the tracking stations will have 85-feet-in-diameter antennas, capable of transmitting and receiving. These giant, revolving steel and aluminum saucers are able to send and receive signals hundreds of millions of miles to and from space.

It was at Goldstone that JPL bounced signals off the planet Venus—35-million miles away. This two-month experiment gave us valuable data about the distance and surface of Venus and helped maintain the United States as the leader in planetary radar astronomy.

Communicating with deep space probes is just one function of the three stations of DSIF. Their primary job is tracking all the spacecraft designed by JPL to fly-by, orbit, and land on the moon and planets. Because the stations provide 360° coverage around the earth, one the three will always be in contact with each distant spacecraft flight and after it arrives.

DSIF is an essential participant in the many space projects at J Ranger, Surveyor, Mariner. Some of these spacecraft are immine Others are on JPL blackboards. All will bring new technologies, n knowledge of our planets and the topless universes beyond, and a s greater understanding of our own small world.

To carry on these vital projects, we need top scientists and engine of many different disciplines. We need people who love their work, w want to know, and want to participate in the exploration of other worl If you believe you're qualified, then come explore with us. Write tod

**JET PROPULSION LABORATORY**

4812 Oak Grove Drive, Pasadena, California

Operated by California Institute of Technology for the National Aeronautics and Space Administration

*All qualified applicants will receive consideration for employment without regard to race, creed, color or national origin.*

Jpl

NEEDS SENIOR RESEARCH ENGINEERS AND SCIENTISTS

- To study space communications codes for efficiency, error correction, security, reliability, guidance, and control. Must have Ph. D. with one year's experience or Master's Degree with three years' experience in discrete mathematics and applications to information theory, coding problems, and statistical communication theory.
- To study the various phases of space flight operations including tracking and orbit determination. Must have M.S. in mathematics or related field and thorough knowledge of classical physics, plus three years experience in data analysis, statistics, trajectories, etc.
- To design, develop and evaluate convertors and/or invertors. Must have B. S. Degree in electrical engineering and two to five years' experience in magnetics, transistor circuitry, power systems, rotating machines, and static invertor design.

Other opportunities exist for electronic engineers and physicists in many areas at JPL which has been assigned by NASA the responsibility for the nation's Lunar, Planetary, and Interplanetary unmanned exploration programs.

Send complete qualification resume now for immediate consideration.

*All qualified applicants will receive consideration for employment without regard to race, creed or national origin.*

U. S. citizenship or current security clearance required.

**JET PROPULSION LABORATORY**
California Institute of Technology
**4812 Oak Grove Drive**
**Pasadena, California**

# NEW AEROSPACE PRODUCTS

## Camera Designed to Photograph Suspicious Vessels

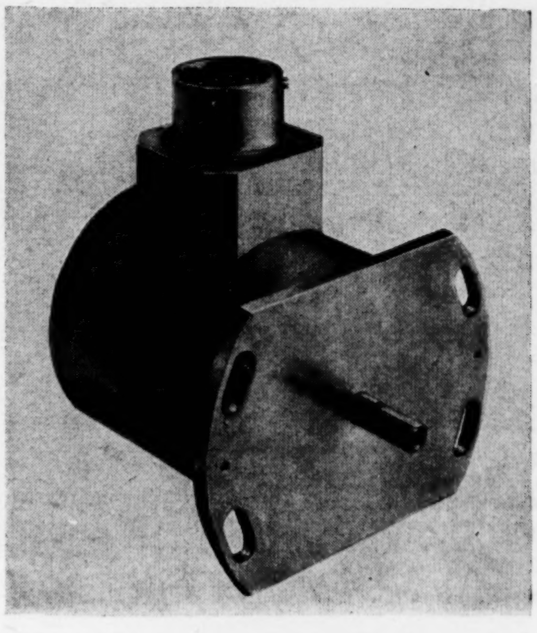
**Navy pilot, from the right seat of a Grumman S2F ASW aircraft, demonstrates the use of the KE-28A camera designed to record evidence of Russian submarines and trawlers operating near American missile-firing and radar installations. The KE-28A camera, replacing a modified wing camera, has a fast rewind mechanism allowing the operator to wind, focus, snap the photo and rewind in 2 sec. Chicago Aerial Industries, developer of the KE-28A, is producing 1,000 for the Navy. Avionics dome atop the fuselage is passive ECM antenna.**

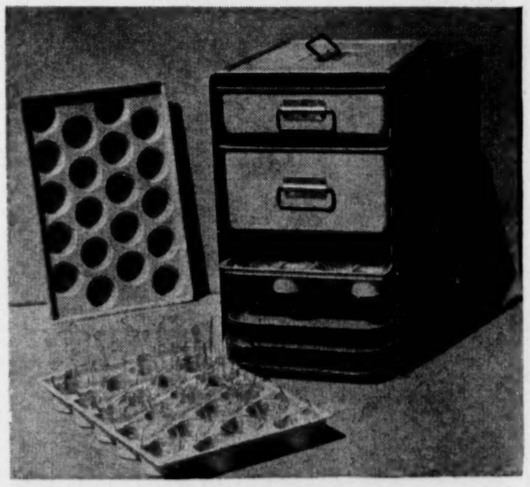
### Jet Vane Actuator

Vernier control jet vane actuator for guided missiles and powered space vehicles is in production for use on the Ranger space vehicle.

The actuator contains electrically isolated control and telemetering data elements, and has shaft position control over a range of ±25 deg. Driving member is a direct coupled d.c. torque motor. Output torque is 2.5 oz. in. over full travel with under 3 watts input power. The 0.5 lb. actuator is 1.75 in. in diameter and 2 in. long.

**Aeroflex Laboratories Division, 34-06 Skillman Ave., Long Island City, N. Y.**



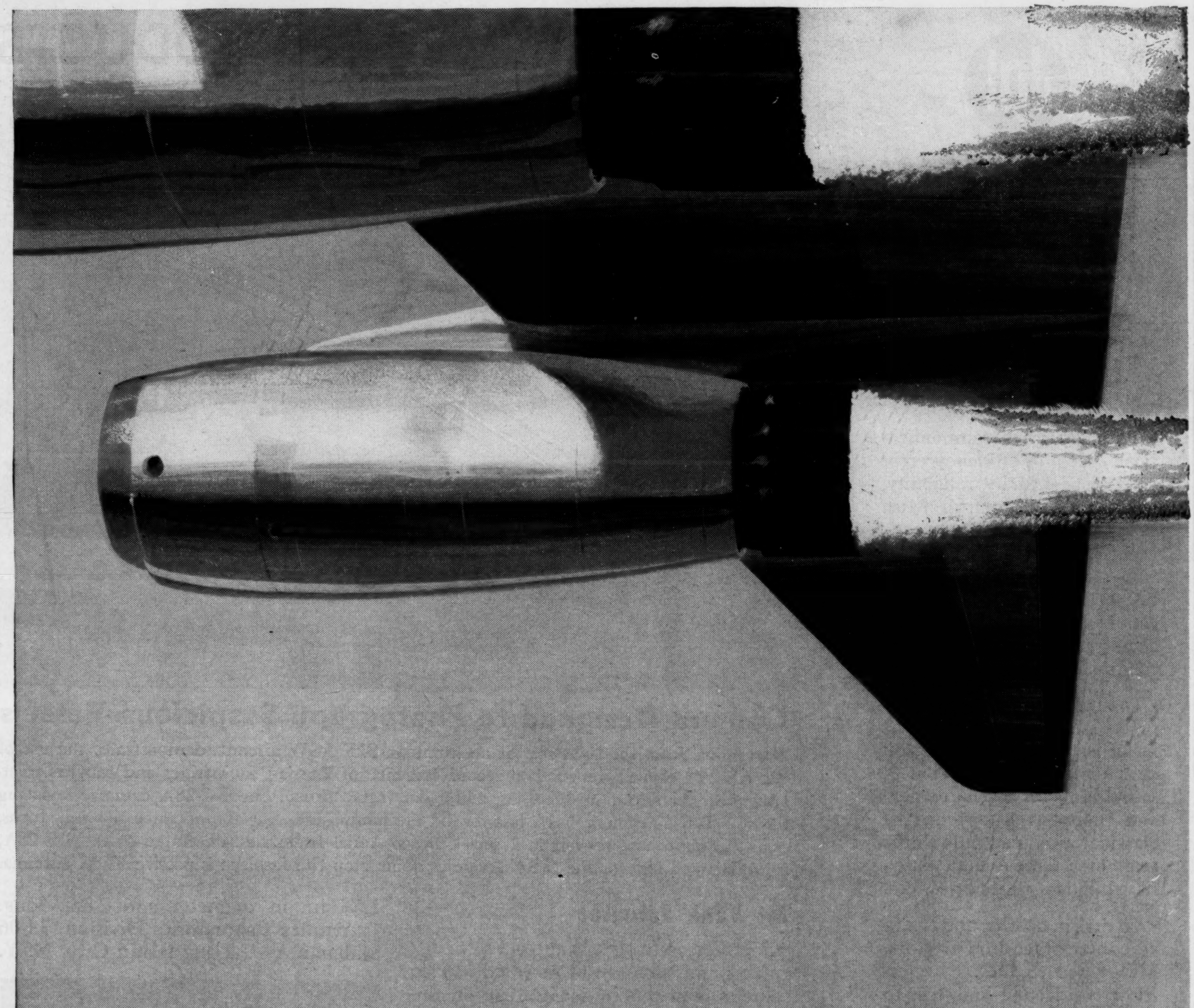


### Aircraft Food Container

Glass fiber container for transport aircraft galley service is used by Swissair. The container, constructed of Douglas Aircraft Corp.'s Aircomb panels, weighs 11 lb. and can carry 240-lb. loads.

The container sidewalls are Aircomb panels bonded to a metal frame, and a polystyrol insert with drawer guides is mounted within the box. The door has a flush latch and opens 270 deg. to fold out of the way. Container dimensions are 12 x 19 x 16½ in.

**Vacumat A.G., Elgg, ZH Switzerland.**



**Confidence counts** and the airlines count on Sinclair

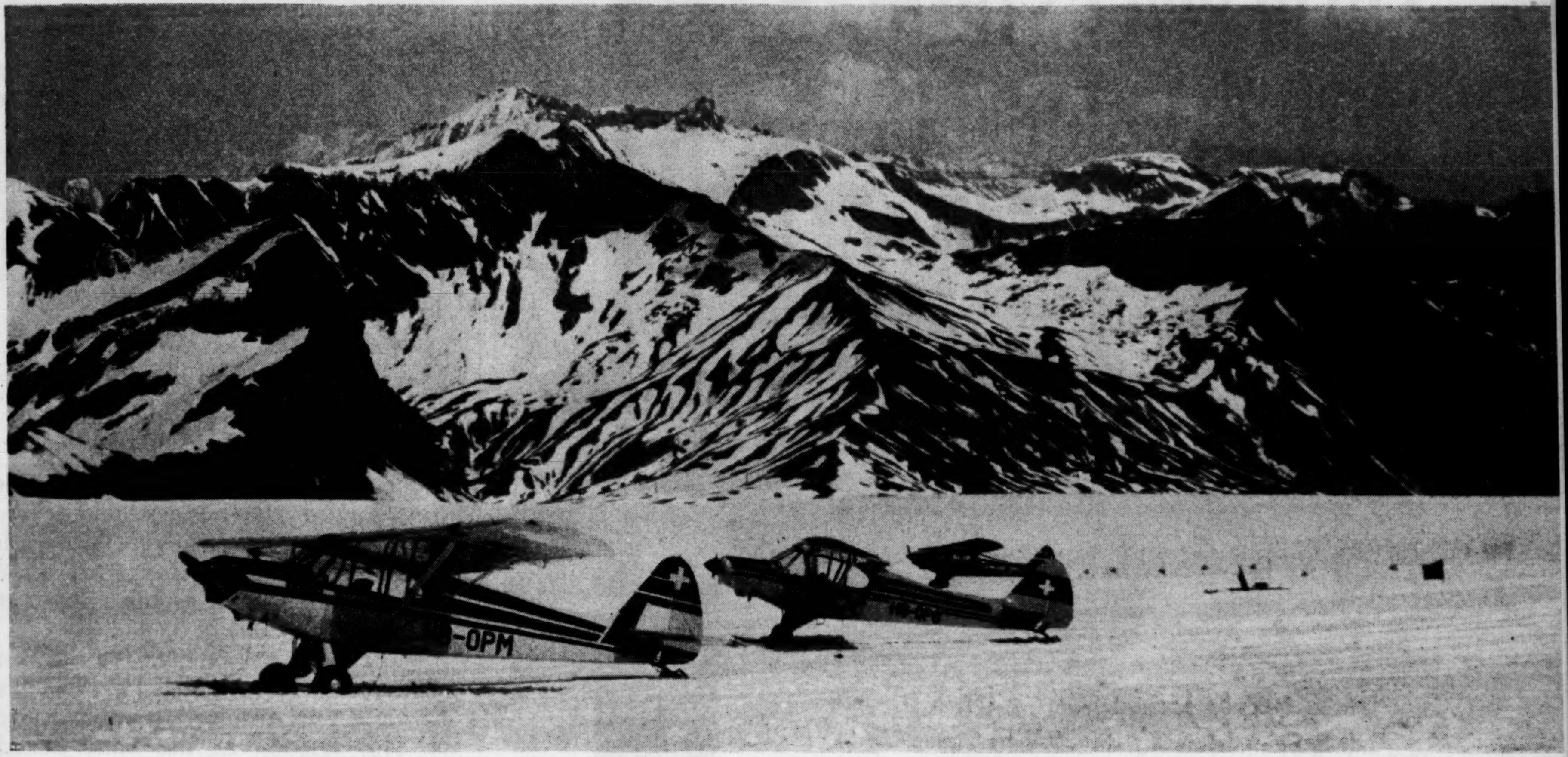
45% of the aircraft oil used by major scheduled airlines in the United States is supplied by Sinclair. Military jets also count on Sinclair to supply Sinclair Aircraft Oil to lubricate their mighty engines. There is no better proof of reliability.

**Sinclair AIRCRAFT OILS**

Sinclair

Sinclair Refining Company Aviation Sales, 600 Fifth Ave. • New York 20, N.Y.

# BUSINE$S FLYING



**ZANFLEURON GLACIER,** 10,000 ft. above the Swiss resort of Les Diablerets, where a new airport is being built. Aircraft shown here on unimproved glacier are Super Pipers from the Swiss Aero Club at Sion in the Valais.

# Swiss 'Glacier' Airport Construction Begun

Les Diablerets, Switzerland—Construction is under way here on what its sponsors term "the world's first glacier airport."

Situated on the approximately 10,000-ft.-high Zanfleuron glacier, the 3,936-ft.-long main and 1,968-ft.-long auxiliary runways are being built to serve year-round skiers and tourists in the Les Diablerets resort region, which borders on the three southwesterly Swiss cantons of Berne, Vaud and the Valais.

Protected by the Becca d'Audon-Oldenhorn mountain range to the northeast and to the west by the Diablerets peak, the perpetual ice and general conditions of the Zanfleuron plateau are ideal for the establishment of an airport at such an altitude.

When the runways are completed by July-August this summer, the airport will be under the direction of Hermann Geiger of Sion, a Swiss alpine rescue pilot and one of the originators of the plan. He already uses it for the training of student pilots in his glacier landing and takeoff technique (AW Apr. 4, 1960, p. 126) and has made more than 1,000 landings on the unimproved strip thus far.

Beginning this summer, a series of regular tourist flights will be introduced between the nearby Rennaz-Montreux Airport, and later on several daily year-round plane shuttle services to Zurich and Geneva, and the glacier.

A three-section cable lift connecting

## U.S. Business & Utility Aircraft Shipments

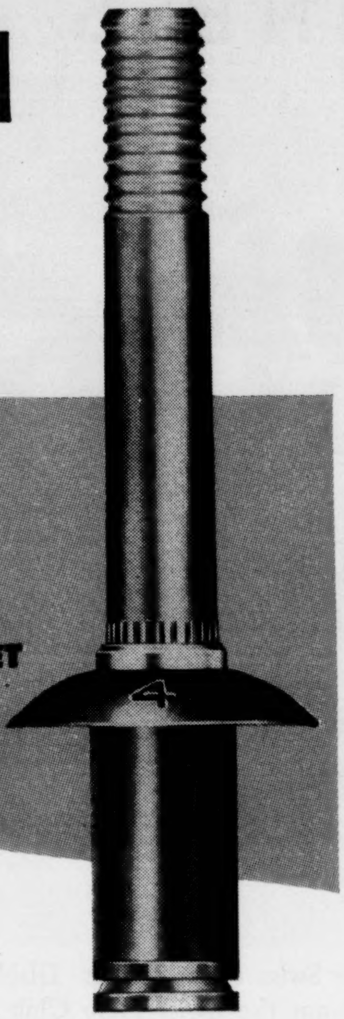
April, 1961

| Make & Model | No. of Units | Factory Net Billing |
|---|---|---|
| Aero Commander 500A, E | 7 | $1,106,000 |
| 560F | 1 | |
| 680E, F | 5 | |
| Beech 18 Super | 1 | $2,750,000 |
| 33 Debonair | 12 | |
| 35 Bonanza | 21 | |
| 50 Twin-Bonanza | 4 | |
| 55 Baron | 22 | |
| 65 Queen Air | 2 | |
| 95 Travel Air | 1 | |
| Callair A-5 | 2 | $68,000 |
| A-6 | 7 | |
| Cessna 150 | 16 | $3,125,000 |
| 172, Skyhawk | 60 | |
| 175, Skylark | 3 | |
| 180 | 11 | |
| 182, Skylane | 36 | |
| 185 Skywagon | 38 | |
| 210 | 17 | |
| 310 | 16 | |
| Lake LA-4 | 1 | $22,000 |
| Mooney Mark 21 | 20 | $368,000 |
| Piper PA-18-95 Super Cub | 1 | $2,706,000 |
| PA-18-150 Super Cub | 16 | |
| PA-22 Colt | 112 | |
| PA-22 Tri-Pacer | 1 | |
| PA-23 Apache | 14 | |
| PA-23 Aztec | 11 | |
| PA-24 Comanche 180 | 18 | |
| PA-24 Comanche 250 | 38 | |
| PA-25 Pawnee | 24 | |
| Totals | 538 | $10,145,000 |

Note: Shipments January through April total 2,350 units having a total factory net billing of $45,432,000, which compares with 3,044 units having a total factory billing value of $59,087,000 shipped in the same period last year. Based on reported shipments thus far this year, April did not continue to show the increase that March showed over previous months in 1961—rather showed a decline of 89 units and nearly $2 million in factory billings, indicating continued dealer resistance in the face of a still soft market. Cessna is increasing its output for May, June and July some 200 units above that planned earlier for those months. Beech also is modifying previous production schedules upward (AW May 29, p. 69).

# SOLID RIVET STRENGTH WITH BLIND RIVETS

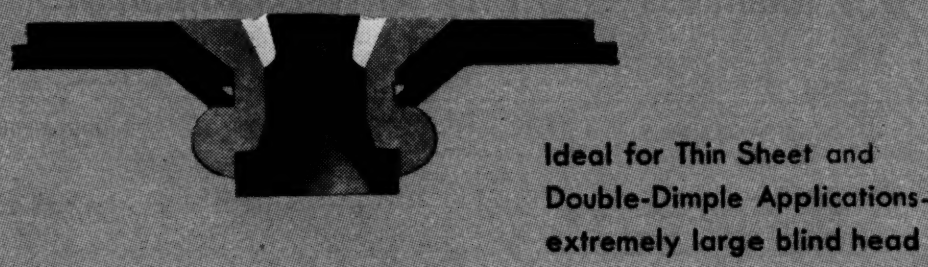
**CHERRYLOCK RIVETS for Your Difficult Solid Rivet Applications**



**BULBED CHERRYLOCK**

**ONLY THE BULBED CHERRYLOCK RIVET GIVES YOU ALL THESE ADVANTAGES**

Mechanically Locked Stem • Flush Fracture (No Stem Trimming) • Positive Clamp-Up • Full Grip Range • Complete Hole Fill • Minimum Blind Side Clearance • Positive Visual Inspection (Grip Length Marked on Head)



**Ideal for Thin Sheet and Double-Dimple Applications—extremely large blind head**

The Bulbed Cherrylock* offers a blind rivet that installs and performs like a solid rivet. Bulbed Cherrylock Rivets will qualify where you are now using solid rivets, offering higher joint strength with greatly increased joint reliability under critical loading conditions—fatigue, shake and sonic vibration.

Now Cherrylock rivets give you a blind rivet that can be used in expensive forgings as well as for joining and attaching sheets and components.

For technical data on Cherrylock Rivets, write Cherry Rivet Division, Townsend Company, Box 2157N, Santa Ana, California.

* Patent Pending

**CHERRY RIVET DIVISION**

SANTA ANA, CALIFORNIA

**Townsend Company**

ESTABLISHED 1816 • BEAVER FALLS, PA.

In Canada: Parmenter & Bulloch Manufacturing Company, Limited, Gananoque, Ontario

the Zanfleuron plateau with the surrounding Les Diablerets area in the valley also is planned and, depending upon the initial popularity achieved by the first two projects, a glacier hotel, open to guests throughout the year, may be built at a later date.

Two independent, separately run companies have been formed for both the airport and cable lift enterprises. They are receiving support of the cantonal authorities although financing is being provided by private investors.

## Business Plane Sales Off From 1960 High

Piper Aircraft Corp. deliveries for June totaled 260 business and utility aircraft valued at $2,790,834, which compares with 215 units shipped in the same month last year having a total net factory billing value of $3,482,639.

Piper factory shipments for the first six months of 1961 totaled 1,459 units having a total net factory billing value of $16,947,834. In the same period last year the manufacturer shipped 1,477 aircraft valued at $22,249,000. June, 1961, breakdown—22 PA-18-150 Super Cubs, 129 PA-22 Colts, 6 PA-23-160 Apaches, 17 PA-23-250 Aztecs, 9 PA-24-180 Comanches, 24 PA-24-250 Comanches, 37 PA-25-150 Pawnees and 16 PA-28 Cherokees.

Total sales of $53,333,219 have been recorded by Beech Aircraft Corp., Wichita, Kan., for the first nine months of its current fiscal year, with net earnings after taxes amounting to $1,743,708. Earnings equaled 64 cents per share.

Sales for the period were down from the same period last year, when Beech reported $78,535,573. Earnings were down from last year's nine months $3,737,688, which equaled $1.40 per share. The company's board of directors announced payment of a regular 15-cent quarterly dividend payable Aug. 2 to holders of record July 21, pointing out that shareholders in Fiscal 1961 will receive an increase in dividends of more than 12% over last year considering the 3-1 stock split of last November.

Sales of business and utility aircraft for the first nine months of 1961 totaled $32,314,563. Although this is off about 11% from last year's record high of $36,351,489, sales were up 25% from the firm's second highest year—1959—and were noticeably higher than military sales for the current period. Military sales for the first nine months of the year totaled $21,081,656 compared with $42,184,084 for the same period last year. The decrease was in line with predictions made by company officials last fall in view of the phase-out of McDonnell F-101, Lockheed F-104 and Convair F-106 subcontracts. Indications are that Beech will meet its projection of some $25 million in military business for Fiscal 1961.

Particularly noteworthy is the sharp gain in export sales—these were up 43% over the same period last year and two European distributors have achieved first and second place in distributorship sales for the entire organization, including the domestic sales organization.

## Soviet Amur Sailplane Testing Is Completed

**Moscow**—New Russian single-place, ultra-light, all-metal Amur sailplane has completed government tests. Experimental models of the standard-class, aluminum alloy craft, which weighs only 190 kg. (419 lb.), are said to have cost less than Soviet metal gliders now in quantity production.

During final tests, an Amur was lifted nose first to an altitude of 1,000 meters by an Mi-1 helicopter. When the tow cable was released, the test pilot reportedly brought the Amur out of its tail spin and put it into a dive with a loss of only 100 meters altitude.

## PRIVATE LINES

**Field Aviation Co., Ltd.,** has been appointed exclusive Beech Aircraft Corp. representative to the Canadian government. Field Aviation is the distributor of the Beech line for all of Canada west of the Ontario-Quebec border.

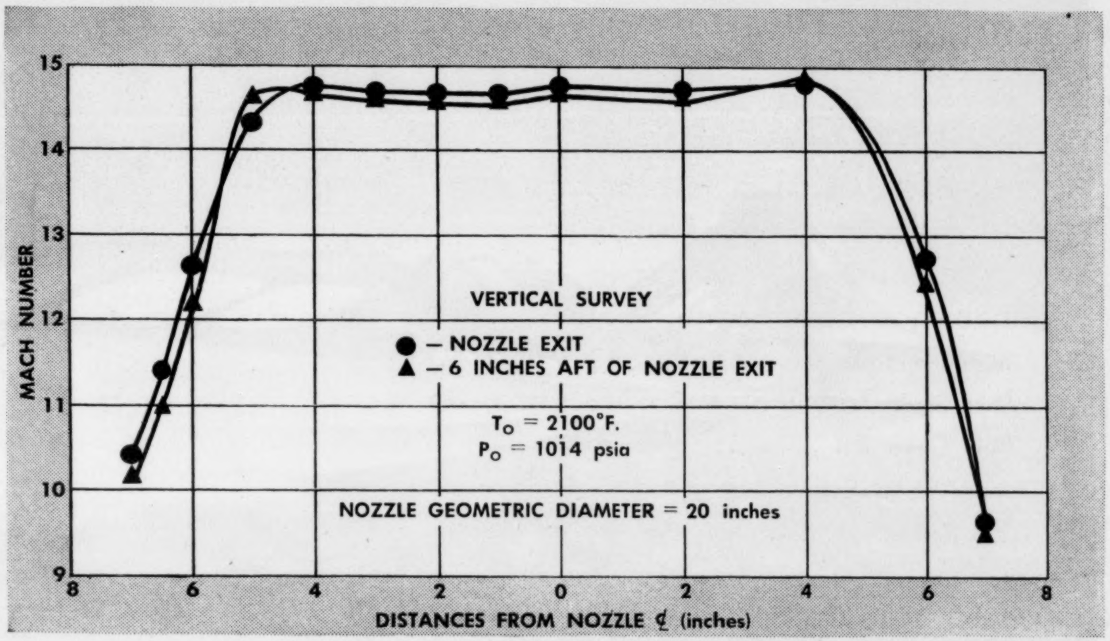
**AirKaman,** a subsidiary of Kaman Aircraft Corp. will erect a flight service facility costing an estimated $500,000 at Bradley Field, Conn. Facility will include a 20,000 sq. ft. hangar and facilities for sales, service and repair.

**Shinn Engineering Co.,** builder of the Shinn 2150-A, is planning to further expand into the light aircraft market. Already built is a prototype model which will sell for less than the standard 2150-A priced at $8,950 (AW June 12, p. 119). It will be cheaper than the 2150-A primarily because of the elimination of flaps and some extras. Also in advanced design stages is a four-place aircraft similar in configuration to the 2150-A which probably will be powered by a 250-hp. engine.

**Extra 240 gal.** of fuel is available for the Grumman Gulfstream via installation of additional 800-lb. internal fuel tanks in each outer wing panel, increasing the range of the Gulfstream to 3,000 stat. mi. plus 45-min. reserve.

MACH 14.7 DATA

The graph below presents calibration data at two stations downstream of the nozzle in the new **FluiDyne** Hypersonic Flight Simulation Facility.



THIS NEW **FluiDyne** FACILITY CAN PROVIDE YOU WITH TEST CONDITIONS AS FOLLOWS:

**Mach No. . . . . . . . . . . . . . . . . 7.0 to 18**
**Stagnation Pressure . . . . . . To 2000 psia**
**Stagnation Temperature . . . . To 4000° R**
**Run Time . . . . . . . In excess of 1 minute**
**Flow Medium . . . . . . . . . . . . . . . . . . Air**

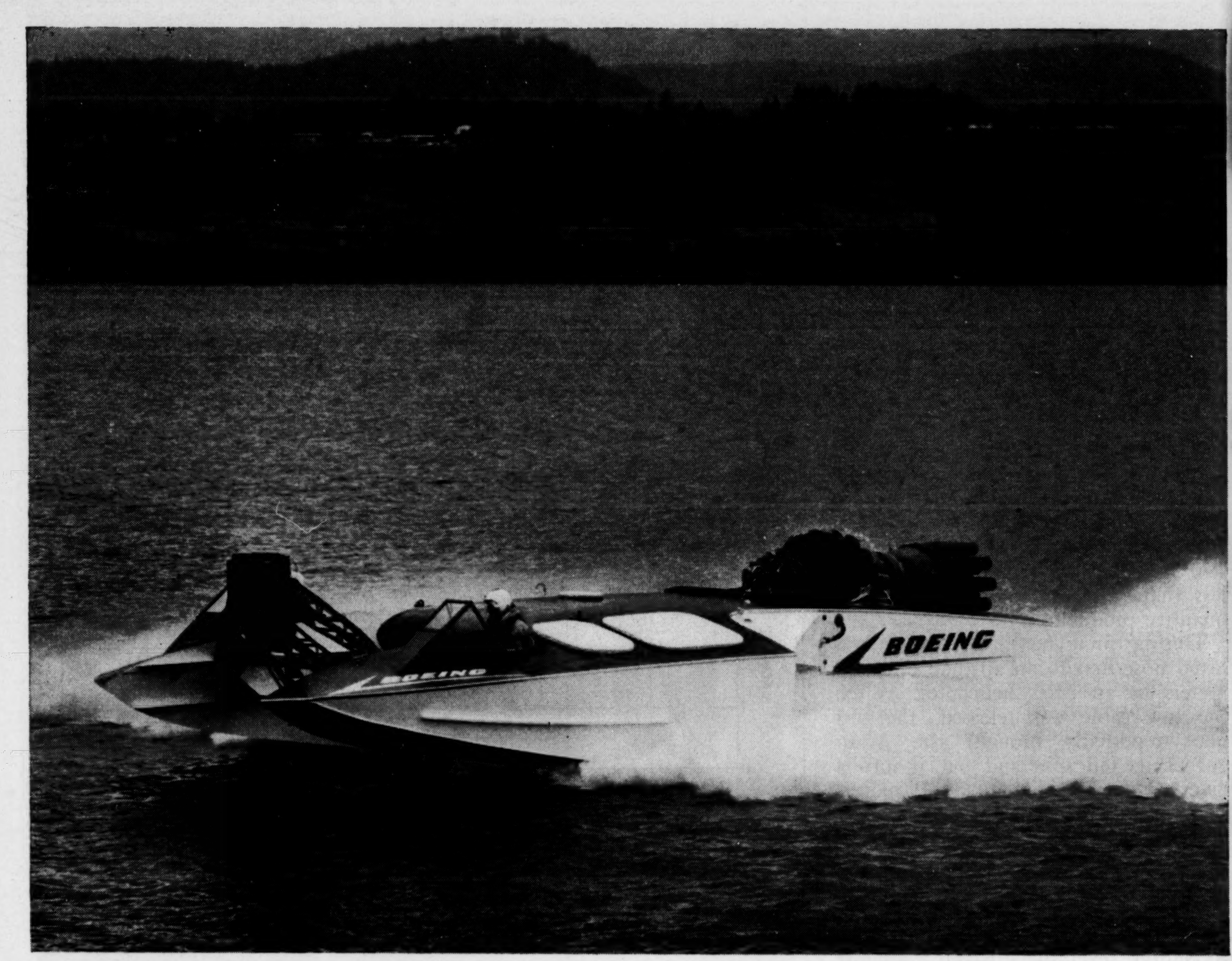
Nike Zeus, Saturn, and Dynasoar programs have been run or are scheduled.

**FluiDyne** has the experience and facilities to help you with research, evaluation, or testing programs in ablation, heat transfer, force measurement, or base heating. Inquire now for detailed information about your specific requirements.

**FluiDyne**
**ENGINEERING CORP.**

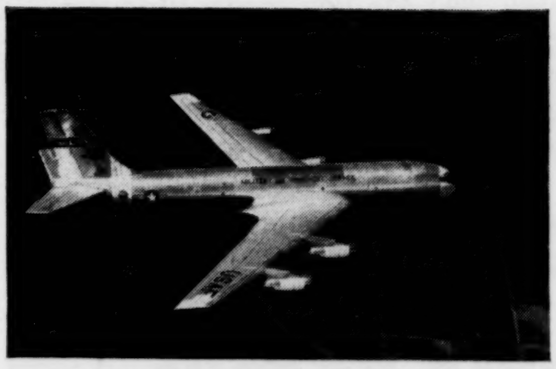
**5740 Wayzata Blvd., Minneapolis 16, Minn.**
**TWX MP-793 • Phone LIberty 5-3791**

We hope you will picture **FluiDyne** as a good place to work. Excellent opportunities exist in hypersonic aerodynamics, heat transfer, instrumentation and controls. Write or phone and tell us the nature of your experience and ambitions.



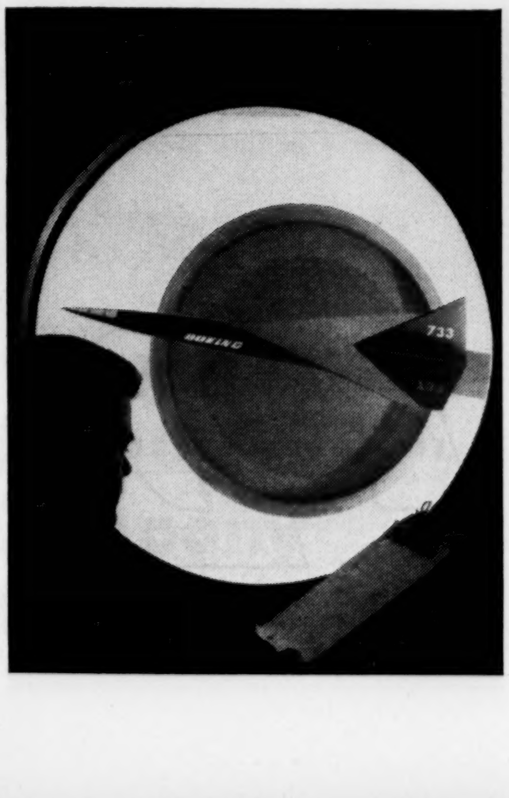
**JET TEST BOAT.** Boeing jet-powered research hydroplane, capable of speeds up to 100 knots, is newest addition to Boeing equipment devoted to advancing man's knowledge. Aqua-Jet will be used to test experimental hydrofoil designs. Test model is suspended between prows from structure which controls action of model being pushed through water. These hydrodynamic design studies are typical of expanding Boeing efforts in marine field, which include building a hydrofoil patrol craft for U.S. Navy.

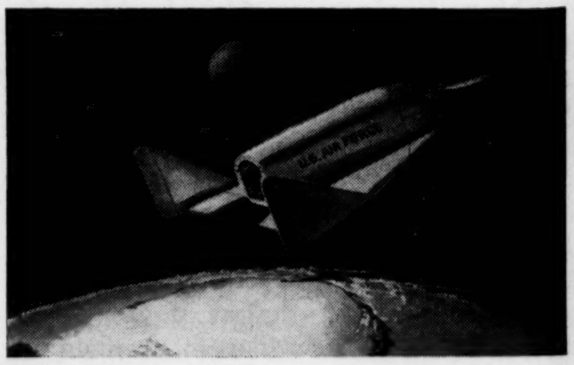
*Capability has many faces at Boeing*



**CARGO-JET.** Boeing C-135 cargo-jet, first of 30 ordered by the Military Air Transport Service, has already been delivered. These 30 C-135s will provide MATS with work capability equivalent to 100 propeller-driven transports.

**SUPERSONIC** transport model being tested in Boeing wind tunnel. Boeing is investing substantial sums in supersonic transport research. Future skyliners would be able to fly from New York to London in less than three hours.





**SPACE GLIDER.** Drawing of Dyna-Soar, U.S. Air Force manned space glider designed to rocket into space, then re-enter earth's atmosphere for conventional pilot-controlled landing. Dyna-Soar is being developed by U.S. Air Force in cooperation with NASA, with Boeing as prime contractor for both the system and the glider.

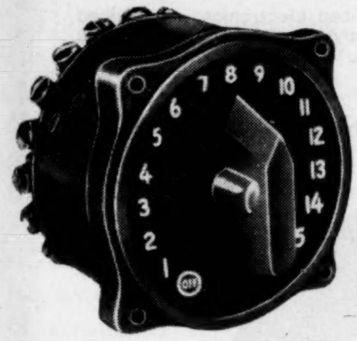
**BOEING**

LEWIS

SELECTOR SWITCHES for

- **Resistance Thermometers**
- **Thermocouple Thermometers**

THERMOCOUPLE SWITCHES



**Flanged Cases in 2 inch 3 inch 4 inch dia.**

Engineered to give years of service in test work as well as in permanent installations, LEWIS switches have heavy, low-resistance contacts; positive detent action and sturdy terminals for easy wiring.

The cases are splash proof and dust tight, of close fitting bakelite. Husky black-finished aluminum indexing knobs are used to turn the stainless steel shaft supporting the rotating brushes.

RESISTANCE BULB SWITCHES

A companion line of the same construction except that they are fitted with a common-terminal ring for three-wire bulb connections.

THE 9S SERIES
*THE SPACE SAVERS*

FOR AIRCRAFT RESISTANCE THERMOMETERS

1¼" dia.

Small, sturdy, steel-cased switches 1¼ inches in diameter, 2-9/32 inches total shaft length, one hole mounting with ½-32 NS-2A threaded bushing. Designed especially for connecting two or more resistance temperature detectors to one instrument, now flying in the modern jets.

*Write for our descriptive bulletin on Selector Switches*

The LEWIS ENGINEERING CO.
*Specialists In Temperature Measurement*
NAUGATUCK, CONNECTICUT

# FINANCIAL

## New Offerings

**Gyrodyne Company of America, Inc.**, St. James, N.Y., engaged in the design, engineering and manufacture of coaxial design helicopters having two rotors, mounted one above the other on a single axis and rotating in opposite directions; the company's business is currently dependent upon one customer, the Department of the Navy, which accounts for all of its business, primarily in connection with its Destroyer Anti-Submarine Helicopter program. Offering is $1,500,000 of convertible subordinated debentures, due 1976, (with attached 6-year warrants) and 90,000 shares of common stock, for public sale in units consisting of $50 of debentures (with a warrant to purchase one common share) and three common shares. Of the 90,000 common shares, 30,000 are outstanding and are to be offered with the units by Peter J. Papadakos, president and principal stockholder. Interest rate of the debentures, public offering price of the units and underwriting terms to be supplied by amendment.

Proceeds from the sale will be used for the redemption of preferred stock; for the construction of an engineering office building and a flight test hangar together with concrete aprons; for the purchase of machinery and equipment to be used for the fabrication of helicopter components, and for the purchase of furniture and fixtures; to replace working capital used for plant expansion and purchase of equipment since May, 1959; the balance will be added to working capital to finance increased work in process inventories.

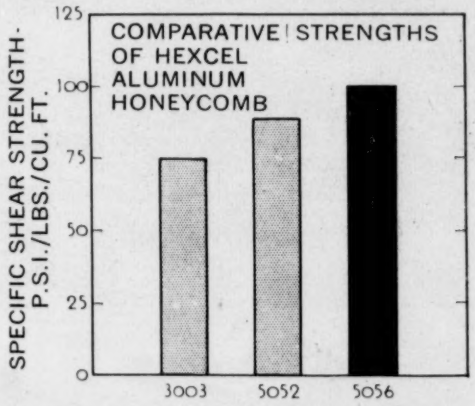
**Electronic Capital Corp.**, San Diego, Calif., licensed under the Small Business Investment Act of 1958 and registered as a closed-end non-diversified management investment company under the Investment Company Act of 1940; the company provides long-term investment capital and management services to small business concerns particularly in the electronics field. Offering is 612,463 shares of common stock, for subscription by common stockholders at the rate of one new share for each three shares held; record date, subscription price and underwriting terms to be supplied by amendment. Proceeds will be used to make additional investments in small business concerns, principally in concerns not now represented in the company's portfolio.

**Fifth Dimension, Inc.**, Princeton, N. J., engaged in the design, development, manufacture and sale of precision in-

20% STRONGER LIGHTER

HONEYCOMB CORE OPENS NEW DESIGN HORIZONS

Hexcel's new 5056 aluminum alloy honeycomb core is at least 20% stronger than any other core of the same weight. This important advance brings two major benefits to the designer and user of honeycomb structures. First, it allows a further weight reduction in present honeycomb uses. Second, and perhaps of greater importance, it opens a wide new range of design applications where the increased strength of 5056 alloy is essential.



New 5056 alloy contains the same metals as Hexcel's 5052, with a significant increase in magnesium content. Current tests indicate that 5056 has the highest strength-to-weight ratio of any aluminum honeycomb ever made.

Hexcel 5056 honeycomb offers an immediate solution to design problems of weight and strength in the aircraft, space vehicle and missile fields, and promises new applications in electronics, construction, and packaging.

For detailed test results and complete data on Hexcel 5056 Honeycomb, write Dept. E-7.

HEXCEL® PRODUCTS INC.
*Stronger, lightweight materials for industry*
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**Major talents at the focus of Kollsman capabilities encompass every intellectual discipline having direct or indirect bearing on man's control of motion in aerospace. This deep involvement of ranking scientific minds in the total research problem is the mold of sophisticated military and civilian hardware today . . . the catalyst of more advanced systems tomorrow.**

Kollsman Instrument Corporation
80-08 45th Avenue, Elmhurst 73, New York | Subsidiary of Standard Kollsman Industries, Inc.

Kollsman Research Division: Applied Physics • Advanced Optics • Advanced Electronics • Advanced Mechanics • Solid State Technology • Systems Development • Systems Analysis • Systems Applications

struments for measurement and control applications. To date virtually all of the company's sales have been of a single product line, "Scanalog" commutators, which are electromechanical data scanning and switching products; such sales were made either directly or indirectly to the government for application in missile or satellite development and test program. Offering is 60,000 shares of common stock, for public sale on an all or none basis; public offering price and underwriting terms to be supplied by amendment. Proceeds will be added to general funds for use particularly for increased research and new product development expenditures.

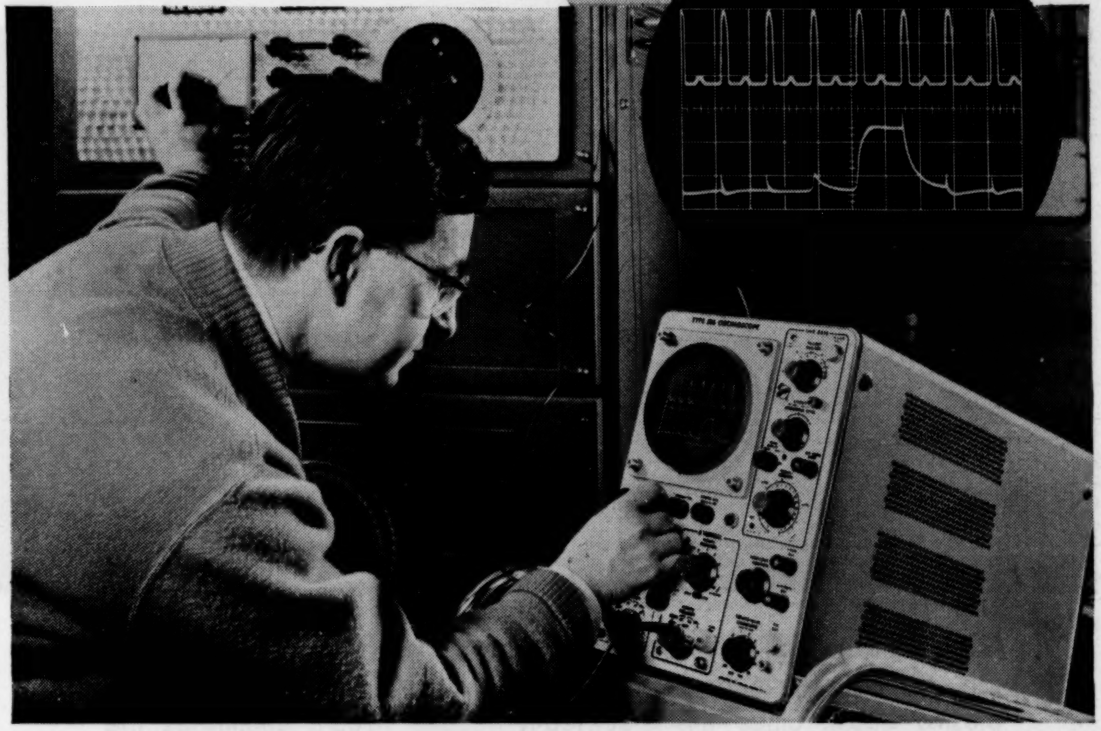
**Dallas Airmotive, Inc.,** Dallas, Tex., engaged primarily in the overhaul of aircraft piston and turboprop engines for commercial and military customers. The company (formerly Aviation Activities Co.) is the survivor of a May, 1961, merger with a wholly-owned subsidiary, the name of which the company has assumed. Offering is 390,000 shares of common stock; 350,000 shares for public sale by the company, and 40,000 outstanding shares by the present stockholders. Public offering price and underwriting terms to be supplied by amendment. Proceeds from the company's sale together with the proceeds of an institutional loan (in the amount of $850,000) will be used to purchase the land and buildings which compose the company's principal offices and plant in Dallas; to retire existing bank indebtedness incurred in connection with recently completed modifications of facilities and establishment of a production line to permit overhaul of turboprop engines; to expand gas turbine (jet and turboprop) overhaul capacity; the remainder will be added to general funds for financing inventories and other general corporate purposes.

**Vinco Corp.,** Detroit, Mich., conducts business through two divisions: The Vinco Division, Detroit, engaged in the manufacture and sale of precision tools and gages, checking and production instruments and precision production parts, and the Recony Division, Richmond, Va., engaged in the design, manufacture and sale of ground support servicing and testing equipment for military aircraft and missiles. Offering is $2,000,000 of 6% convertible subordinated debentures, due 1976, for public sale at 100% of principal amount, on an all or none basis. Proceeds will be applied to additions and improvements to plants and facilities; for the payment of a note and retirement of outstanding 5% preferred shares; for the repayment to Rhodes Factoring Co., Inc., of working capital advances; for research and development on temperature control systems.

Tektronix DUAL-TRACE Oscilloscope
Used in *Development of* High-Speed Welder

New, high-speed, precision welder developed at MAXIM CONTROLS COMPANY utilizes a controlled gate pulse—rather than capacitance decay—for joining high-temperature alloy materials, such as those used in manufacturing structural "honeycomb" cores.

In development of this new welder the Tektronix Type 516 Oscilloscope was used for monitoring the time length of individual welds—since as many as six welds can be set to occur simultaneously or any number, sequentially—and for observing the constant amplitude and width of gate signals—thus assuring uniform bonds at speeds up to 2000 welds per second.



*Adjusting pulse width and height of welding signal from newly developed Welding Control apparatus developed by MAXIM CONTROLS COMPANY, Portland, Oregon.*

***By observing the dual-trace display on the Tektronix Type 516 Oscilloscope, the Project Engineer easily checks a welding gate output (lower trace) with respect to the trigger pulses (upper trace) and quickly notes any variations.***

TEKTRONIX ®

Consider the Type 516 Oscilloscope for your own DC-to-15 MC applications. It offers you four operating modes, independent controls for each amplifier channel, bright traces with excellent definition. You can position, attenuate, invert input signals as necessary for your own dual-trace or single-trace research and development projects.

Type 516 performance characteristics include: risetime of 23 nanoseconds, calibrated vertical sensitivity of 50 mv/div to 20 v/div, calibrated sweep range of 0.2 µsec/div to 2 sec/div. Other Tektronix features include: flexible trigger facilities (with high-frequency sync to 20 mc), 5X Magnifier, Amplitude Calibrator, electronically-regulated power supplies.

**Type 516 Oscilloscope** (50-60 cycles) *f. o. b. factory* . . . **$1000**
*For a demonstration of the Type 516 Oscilloscope in your own laboratory, call your Tektronix Field Engineer.*

**Tektronix, Inc.**

**P. O. Box 500 • Beaverton, Oregon • Phone Mitchell 4-0161 • TWX—BEAV 311 • Cable: TEKTRONIX**

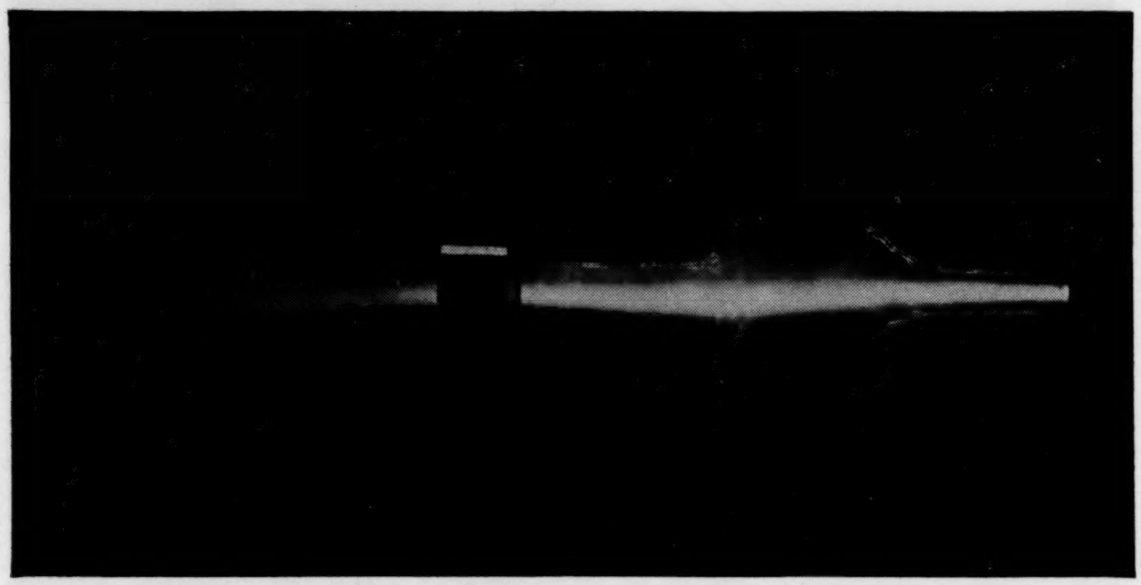
**TEKTRONIX FIELD OFFICES:** Albuquerque, N. Mex. • Atlanta, Ga. • Baltimore (Towson) Md. • Boston (Lexington) Mass. • Buffalo, N.Y. • Chicago (Park Ridge) Ill. • Cleveland, Ohio • Dallas, Texas • Dayton, Ohio • Denver, Colo. • Detroit (Lathrup Village) Mich. • Endicott (Endwell) N.Y. • Greensboro, N.C. • Houston, Texas • Indianapolis, Ind. • Kansas City (Mission) Kan. • Los Angeles, Calif. Area (East L.A. • Encino • West L.A.) • Minneapolis, Minn. • Montreal, Quebec, Canada New York City Area (Albertson, L.I., N.Y. • Stamford, Conn. • Union, N.J.) • Orlando, Fla. • Philadelphia, Pa. • Phoenix (Scottsdale) Ariz. • Poughkeepsie, N.Y. • San Diego, Calif. • San Francisco, Calif. Area (Lafayette, Palo Alto) • St. Petersburg, Fla. • Syracuse, N.Y. • Toronto (Willowdale) Ont., Canada • Washington, D.C. (Annandale, Va.)

**TEKTRONIX ENGINEERING REPRESENTATIVES:** Hawthorne Electronics, Portland, Oregon • Seattle, Washington. Tektronix is represented in twenty overseas countries by qualified engineering organizations.

**In Europe please contact Tektronix International A.G., Terrassenweg 1A, Zug, Switzerland, Phone (042) 4-91-92, for the address of the Tektronix Representative in your country.**

•ELECTRICAL ENGINEERS
•PHYSICISTS

**for advanced studies of high-performance electrical propulsion systems...**



Great interest has been aroused by our unusual oscillating-electron ion engine which produces a high-velocity, electrically-neutral plasma beam. Since this electrically-neutral stream eliminates the space-charge effect, there is no theoretical limit to the thrust capability of the device. ● Past successes and current progress with this device, (and in other areas of plasma research) now require a material expansion in this entire effort. As a result, a number of very attractive Senior Positions are being created for electrical engineers and physicists with advanced degrees and experience. ● These positions should have particular appeal to those interested in studies of high-energy plasma sources, diagnostic techniques, and other basic investigations that will lead to practical space propulsion devices. Included are both theoretical and experimental investigations of factors that determine plasma potentials, ionization and power efficiencies. ● This program is of the long-range sustained type with both corporate and government sponsorship. Superior facilities and assistance are available for numerical computation and experimental work. Publication of papers and origination of new programs is encouraged, as is close contact with related university research. ● Salary levels, benefits and the semi-academic approach will appeal to experienced men with demonstrated abilities.

*You are invited to contact Mr. W. D. Walsh, Personnel Department*

**RESEARCH LABORATORIES**
**UNITED AIRCRAFT CORPORATION**

**400 Main Street, East Hartford 8, Conn.**

All qualified applicants will receive consideration for employment without regard to race, creed, color or national origin.

## WHO'S WHERE

(*Continued from page 19*)

### Changes

**Dr. Webb Haymaker**, assistant director for Life Sciences, National Aeronautics and Space Administration's Ames Research Center, Moffett Field, Calif., and director of the Life Sciences Research Laboratory at Ames.

**Brig. Gen. Francis J. McMorrow**, deputy commanding general, Army Ordnance Missile Command, Redstone Arsenal, Ala.

**Dr. Samuel W. Levine**, technical assistant to the president's office, Fairchild Camera and Instrument Corp., Syosset, N. Y.

**Ralph Braverman**, technical assistant to the president, Babcock Electronics Corp., Costa Mesa, Calif.

**Robert R. Anderson**, chief engineer, Hiller Aircraft Corp., Palo Alto, Calif., and **Herbert Mosely**, project engineer for the Army light observation helicopter.

**Robert H. Craig**, manager of manufacturing operations, Micro Gee Products, Inc., Culver City, Calif.

**Edward A. Hebditch**, executive assistant to the president of Gulton Industries, Inc., Metuchen, N. J.

Civil Aeronautics Board has announced the appointment of **W. Fletcher Lutz, Jr.**, as Deputy Director, Bureau of Economic Regulation, and **Kermit W. Day** as Chief, Management Division, Office of Administration.

**Dr. Edward G. Witting**, manager of research and new products, Cannon Electric Co., Los Angeles, Calif.

Cornell Aeronautical Laboratory, Buffalo, N. Y., has announced that a recently formed Computer Research Department and the Electronics Department now comprise a new Electronics Division. **W. Maurice Kaushagen** is director of the Electronics Division, and remains as acting head of the Electronics Department. **William S. Holmes** is head of the Computer Research Department, with **Dr. Morton G. Spooner** as assistant.

**Drs. Robert L. Hubbard** and **Edgar R. Terry** have been named to the Washington, D. C., research staff of Massachusetts Institute of Technology's Operations Evaluation Group.

**Peter Brooks** will be appointed Deputy Managing Director of the Beagle Group (British Executive and General Aviation Ltd.), London, England, upon his termination as Fleet Planning Manager of British European Airways Corp.

General Dynamics/Electronics' Research Division, Rochester, N. Y., has appointed the following laboratory managers: **Dr. Ernest G. Brock**, Quantum Physics Laboratory; **Dr. Carl E. Drumheller**, Physical Electronics Laboratory; **Dr. Gerald W. Sears**, Molecular Physics Laboratory; **Dr. Hisao Yamada**, Information Processes Laboratory.

**Harry B. Smith**, engineering manager, Westinghouse Electric Corp.'s Air Arm Division, Baltimore, Md.

**James F. McGee**, chief of the Systems Test and Operation Section, Systems Division, Jet Propulsion Laboratory, California Institute of Technology, Pasadena, Calif., succeeding **Dr. Norman F. Jacobson**, now chief of the newly established Program Engineering Section of the Systems Division.

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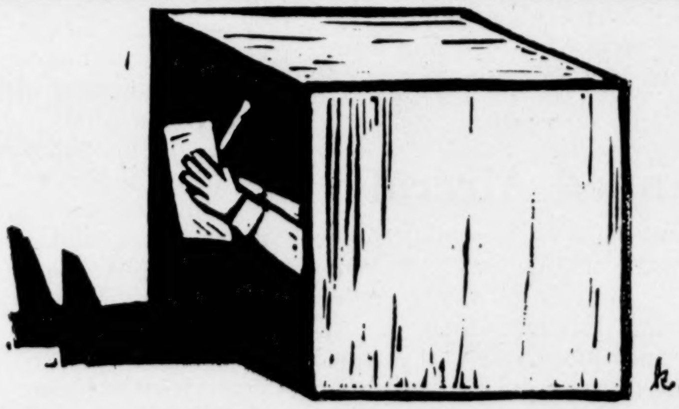

Can $19^{19}$ be represented as the sum of a cube and a fourth power? *—Contributed*

Developing and producing power sources is the business of our Electron Tube Division, Model L-3653 being a recent example. This portable power source provides from 300 to 600 watts of CW or modulated RF microwave power in the 350 mc to 10.5 kmc range. Works well in the field for high power testing of microwave components and systems and as the RF driver for high power microwave amplifier tubes. For more fine points, write: Marketing Dept., Electron Tube Division, San Carlos, Calif.

ANSWER TO LAST WEEK'S PROBLEM: The physicists spent 35 shillings, the engineers also spent 35 shillings, the productivity managers spent 42 shillings, and the comptrollers spent 21 shillings.

LITTON INDUSTRIES, INC.
Beverly Hills, California

# LETTERS

## Bounder Design

Re: "Soviet Union Displays Supersonic Bomber" (AW July 3, p. 27).

Has it occurred to you or to your readers that:

1. A prototype nuclear airplane would not have "radomes and other fuselage projections";

2. the two large nacelles at mid-semispan of the wing house indirect-cycle nuclear-engine heat exchangers, using air for the thrusting fluid;

3. the two engines mounted at the wing tips are conventional large turbojet engines, used for takeoff and speed dashes up to Mach 2.

Two and one-half years (December, 1958, to July, 1961) would be about right to install the nuclear propulsion system in a proven testbed, proven in two and one-half years of flight tests.

And if I'm not mistaken, Bounder has been aided and abetted by Dick Whitcomb's (NACA) "area rule."

Lastly, Bounder reminds me of Convair's SST proposal based on the B-58 design (new fuselage, new horizontal and vertical tails, new engines, old wing planform).

Matter of fact, I wonder if the picture might not be stamped "Made in USA." Remember the Russian picture of the TF-100C (F-100F) a couple of years ago that they tried to pass off as one of their new fighters. That particular picture was taken at LA International Airport. I wonder where the picture of the Bounder originated.

James A. Martin
Lancaster, Calif.

*(Bounder flew over Tushino July 9, 1961, before 500,000 spectators, including Western air attaches and* Aviation Week *editors.—Ed.)*

## For Manned Aircraft

Again I would like to congratulate you on your editorial of July 10 ("A Major Mistake"). Your observation that Congress is displaying the greater wisdom in demanding continued procurement of manned aircraft reflects a feeling which is growing in other segments of government and the public.

It is my hope that the display of continuing systematic development of manned airpower by the Russians will move our country toward the conviction that we must match and exceed the Soviets in all fields—not just missiles or space.

Frank W. Davis
President
General Dynamics/Ft. Worth
Ft. Worth, Tex.

Once again you have set out in forceful language a sound viewpoint on our defense posture.

Your editorial "A Major Mistake" (AW July 10) will, I hope, stir the experts at the palace to do a little more homework.

R. B. Swanson
General Dynamics/Convair
Washington, D. C.

***Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.***

As a strong advocate of manned aircraft, I enjoyed your editorial of July 10 ("A Major Mistake") very much, and would like to congratulate you for saying what I have been wanting to say for a long time.

Lawrence Lee
Civil Engineer
Kingsport, Tenn.

## Selective Approach

For a number of years I have been a subscriber and reader of your fine publication and I appreciate the excellent job your staff is doing by reporting the news of the aerospace industry. In some cases your editorials and policies are outstanding, especially the treatment of the following:

1. The myth of the shortage of engineers in the mid-50's.

2. Outstanding coverage of the U-2 incident.

3. Support for a low-cost, lightweight fighter.

4. The ridiculous recruiting practices for technical personnel.

However, your publication does go overboard when you become a champion of the "more of everything" policy. I speak of your past articles on more Titan, more Minuteman, more Atlas, more B-52, more B-58, more ASW, ANP, etc. A recent example of this policy is Mr. Hotz's editorial entitled "A Major Mistake" published in the July 10 issue. It is just almost unbelievable to think that you influence many knowledgeable people that this nation needs more of everything, especially M-1 fighters.

Privately, industry leaders do not share your views and some think it quite ridiculous. It is believed that this "more of everything" policy compromises the position and name of the aerospace industry. Your approach regarding major development because the Russians have it is quite nauseating. The continual overworking of this cliche by the press and congressional legislators is considered to be on a par with elementary school intelligence.

Your publication enjoys a tremendous respect in the field and is in a position of wielding great influence. I am quite disappointed that you have not promoted R&D programs on a more selective basis. There are many things that your magazine could promote for the betterment of the industry, such as improved procurement policies having incentive cost reduction and profits; the need for more qualified leaders in DOD; the need for improved operating policies and efficiency in government procurement offices; and the need to establish defense and space policies and stop imitating the Russians.

In closing, many readers and members of the aerospace industry are quite disappointed with your dogmatic policy of being the champion of "more of everything." Your outstanding publication can and should make a more worthwhile contribution to the industry.

Robert A. Webster
Palos Verdes Estates, Calif.

## Pilot Medical Checks

It was a great disappointment to many private pilots to learn that the new Federal Aviation Agency Administrator, N. E. Halaby, apparently will continue the bureaucracy-at-any-price policies of his predecessor, Gen. E. R. Quesada.

Mr. Halaby has said that he intends to continue in effect the current FAA policy of requiring third-class medical examinations to be given by "aeromedical experts," until he is shown some reason to discontinue the present system and allow any duly licensed physician to give the exam.

If Mr. Halaby needs some reasons for discontinuing the present medical examination system, he might consider these:

- **Latest figures** I have seen, admittedly a couple of months old, show there are about 2,000 private pilots in the U. S. for every "aeromedical expert." Assuming the average physical to take 45 min. to an hour, as my last one did, then every "aeromedical expert" is going to spend approximately two-thirds of his time giving physicals to private pilots, let alone setting broken legs, diagnosing diseases, performing operations, or doing any of the other things that plain old medical doctors have been doing, without special authorization from a federal agency, for many years.
- **Nobody so far** has shown any reason for the new system to be imperative or, at least, if such need has been determined, it certainly has not been very widely publicized by the FAA. Any medical doctor who cannot competently give a Class III medical examination should not be entrusted with the lives of other persons who suffer from such non-aeromedical diseases as tuberculosis, heart disease, diabetes or gall stones.
- **Aside from purely medical** considerations, the cost and time involved for the average private pilot to hunt up and go to an "aeromedical expert" is, or is rapidly becoming, prohibitive.

I do not like to condemn anything without having heard all sides of the controversy. Despite the fact that a logical, cogent explanation of the reasons for the new system would have taken a great amount of criticism off the back of the FAA, none has been forthcoming.

If there's a good reason for the system, let's hear it.

If there isn't, let's abolish it and go back to using private aviation's greatest aid, common sense.

(Name Withheld by Request)
Irate Private Flier